HYDROCHEMICAL DATA FOR THE EDWARDS AQUIFER IN THE SAN ANTONIO AREA, TEXAS

LP-131

Cooperators: TEXAS DEPARTMENT OF WATER RESOURCES
U.S. GEOLOGICAL SURVEY
CITY WATER BOARD OF SAN ANTONIO

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by

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CONTENTS

	Page
Abstract	1
Introduction	2
Well-numbering system	2
Hydrochemical data	2
Factors controlling water chemistry	7
Areal variations in hydrochemical parameters	8
Hydrochemical facies	8
Dissolved solids	8
Sulfate concentrations	13
Time variations in water quality	13
Selected references	18

ILLUSTRATIONS

		Page
Figure 1.	Map showing location of the study area and hydrologic features of the San Antonio area	3
2.	Map showing locations of wells and springs sampled for chemical analyses	4
3.	Map showing locations of wells and springs sampled for tritium	6
4.	Trilinear diagram to classify hydrochemical facies	9
5.	Map showing hydrochemical facies of the Edwards aquifer	10
6.	Trilinear diagram of the normal sequence of hydrochemical facies from freshwater to saline water in the Edwards aquifer	11
7.	Map showing dissolved solids in water from the Edwards aquifer	12
8.	Map showing sulfate concentrations in water from the Edwards aquifer	14
9.	Graph showing time variations in the chemical composition of water in the Edwards aquifer	15
10.	Map showing variations in the chloride concentrations in the vicinity of the bad-water line	17

TABLES

Table 1.	Chemical analyses of water samples from the Edwards aquifer	20
2.	Tabulation of published reports containing significant amounts of data on the water quality of the Edwards aquifer	26
3.	Tritium concentrations in water from wells and springs in the Edwards aquifer	28
4.	Isotope analyses and redox potential of water from the Edwards aquifer	35
5.	Calculated dissolved carbonate, partial CO_2 pressures, and saturation indices of selected minerals in water from the Edwards aquifer	36
6.	Hydrochemical facies and corresponding water types in the Edwards aquifer	38

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ABSTRACT

This report presents hydrochemical data that was collected as part of the investigations of the Edwards aquifer in the San Antonio area, Texas, during 1970-78 and indicates other sources of available data. The report includes the results of chemical analyses of 159 water samples from 123 wells and springs; tritium analyses for 242 water samples from 120 wells and springs; isotope and redox-potential analyses of 31 water samples from wells, springs, and streams; and calculated dissolved carbonate, partial CO_2 pressures, and saturation indices of selected minerals in 98 water samples from 81 wells, springs, and streams. The water types and hydrochemical facies are given for six zones of the aquifer.

INTRODUCTION

This report, which was prepared by the U.S. Geological Survey in cooperation with the City Water Board of San Antonio and the Texas Department of Water Resources, presents hydrochemical data that was collected as part of the investigations of the Edwards aquifer in the San Antonio area during 1970-78 and also indicates other sources of available data. The purpose of this report is to document the availability of hydrochemical data and to present data describing the chemical characteristics of water in the Edwards aquifer.

The extent of the Edwards aquifer in the San Antonio area is shown on figure 1. The area is bounded by the drainage divides of streams contributing recharge to the Edwards aquifer in the Balcones Fault Zone and by the "bad-water" line, which is the downdip limit of freshwater within the aquifer.

WELL-NUMBERING SYSTEM

The well-numbering system in Texas was developed by the Texas Department of Water Resources for use throughout the State. Under this system, each 1-degree quadrangle is given a number consisting of two digits. These are the first two digits in the well number. Each 1-degree quadrangle is divided into 7-1/2-minute quadrangles which are given two-digit numbers from 01 to 64. These are the third and fourth digits of the well number. Each 7-1/2-minute quadrangle is divided into 2-1/2-minute quadrangles which are given a single-digit number from 1 to 9. This is the fifth digit of the well number. Finally, each well within a 2-1/2-minute quadrangle is given a two-digit number in the order in which it was inventoried, starting with 01. These are the last two digits of the well number.

Only the last three digits of the well number are shown at each well site; the first two digits are shown in the northwest corner of each 1-degree quadrangle; and the third and fourth digits are shown in the northwest corner of each 7-1/2-minute quadrangle.

In addition to the seven-digit well number, a two-letter prefix is used to identify the county. The prefix for counties where wells were sampled are as follows: AL, Atascosa; AY, Bexar; DX, Comal; KX, Guadalupe; LR, Hays; RP, Kinney; TD, Medina; YP, Uvalde; and ZX, Zavala.

HYDROCHEMICAL DATA

The results of chemical analyses of 159 water samples from 123 wells and springs in the Edwards aquifer in the San Antonio area are tabulated in table 1. The locations of wells and springs sampled are shown on figure 2.

In most areas, several wells were available for sampling. To prevent any uncertainty as to the source of the sample, only wells with casing records and known depths were selected for sampling. When possible, only those wells with vigorous natural flow or a large-capacity pump were selected to insure a minimal change in the temperature and chemical composition of the water during residence time in the well bore. All pH and alkalinity measurements were made in the field at the time of sample collection. Field techniques used for determining redox potential, sulfide concentration, and isotopes are discussed by Pearson and Rettman (1976).

A tabulation of published reports containing significant amounts of water-quality data on the Edwards aquifer is presented in table 2. Additional unpublished data on water quality are available in the files of the U.S. Geological Survey in San Antonio and Austin, Texas.

Tritium concentrations were determined in 242 samples from 120 wells and springs (table 3). The locations of the tritium-sampling sites are shown on figure 3.

Tritium is a radioactive isotope of hydrogen with an atomic mass of 3 and a half life of 12.3 years that occurs in the environment as a result of both natural and manmade processes. Tritium is produced naturally by the interaction of cosmic radiation with nitrogen and oxygen in the upper atmosphere and enters the hydrologic cycle during precipitation. One tritium unit corresponds to a concentration of 1 tritium atom per 10^{18} hydrogen atoms and equals 3.2 picocuries per liter. Tritium data can be used in the investigation of the Edwards aquifer to determine the direction and rate of ground-water flow.

A counting error, commonly reported as one standard deviation, is reported with each tritium analysis. This error is calculated so that the true tritium content of the sample has a 67-percent probability of being within the reported range. These analyses were made in the laboratory of the U.S. Geological Survey in Reston, Virginia. The methods of analysis and their significance to the hydrogeology of the Edwards aquifer are discussed by Pearson and others (1975).

The results of analyses for isotopes of carbon and sulfur and for redox potential are given in table 4. Techniques for collection and laboratory analyses of these properties and their significance to the hydrogeology of the Edwards aquifer are presented by Pearson and Rettman (1976).

Isotopes of carbon can be used to determine the rate of ground-water movement and the rates of physical and chemical processes occurring within the aquifer. In addition, they are useful in determining the sources of water.

The sulfur-bearing chemical species most commonly dissolved in low-temperature natural waters are SO_4, HS, and H_2S. The species that dominates in the natural water depends on the oxidation potential (redox) and pH of the system. The possible sources of these species in water from the Edwards aquifer includes evaporitic minerals, decomposition of organic material, solution, oxidation of sulfide minerals, inward migration of H_2S from the saline zone, and recharge of sulfate-bearing precipitation. These sources tend to have differing ranges of stable sulfur-isotope content. The sulfur-isotope data can be used in conjunction with other geochemical and hydrologic data to determine the characteristics of water circulation within the aquifer.

The results of analyses for saturation indices are given in table 5. Saturation indices are measures that indicate if a given sample is undersaturated (SI = a negative number), saturated (SI = 0), or supersaturated (SI = a positive number) with respect to a given mineral. The method by which saturation indices are calculated are given by Truesdell and Jones (1974). A discussion of these indices and their significance to the hydrogeology of the Edwards aquifer are given by Pearson and Rettman (1976).

FACTORS CONTROLLING WATER CHEMISTRY

The mineral composition of the Edwards aquifer within the freshwater zone is essentially calcite. The aquifer contains very small amounts of clay minerals, but some clays have been washed into the aquifer locally in the recharge areas. The upper confining bed of the Edwards aquifer consists predominantly of clay. Dolomite, which occurs where freshwater circulation is slow, is the second most common mineral within the freshwater zone of the aquifer. Dolomite occurs in the lower confining bed of the aquifer and in the basal beds of the aquifer (Maclay and Small, 1976).

Organic materials that were previously present in the freshwater zone of the aquifer have been oxidized and removed by oxygenated water that circulates rapidly through the aquifer. Sulfate minerals, gypsum, and anhydrite were previously distributed through the rocks of the freshwater zone, but they have been rapidly dissolved by circulating water. However, sulfate minerals occur locally within the freshwater zone where circulation is restricted and within the rocks of the lower confining bed. Lenses and layers of evaporitic gypsum and anhydrite provide the source of sulfate ions necessary for the calcification of dolomite in the freshwater zone.

The mineral composition of the saline zone of the Edwards aquifer is more diverse than that of the freshwater zone. Calcite and dolomite are prevalent, but gypsum, anhydrite, celestite, and strontianite are present in lesser amounts. Organic material is common.

The chemical character of the ground water responds to changes in the physical environment along the ground-water flow path. Ground water tends to increase in dissolved constituents and to become more saturated with respect to calcite in the direction of flow because more time is available for solution; however, the inflow of freshwater from recharge areas along the main zone of regional flow strongly modifies this progression. Also, mixing of water within the aquifer with water that has moved vertically into the aquifer through confining beds locally changes the chemical character of water within the aquifer.

The dissolved constituents in the water recharging the Edwards aquifer consist predominantly of calcium and bicarbonate; however the concentrations of dissolved materials vary with changing runoff conditions. During storm periods, the recharge water is significantly lower in dissolved solids and is undersaturated with respect to calcite. During dry periods, the recharge water is the base flow of streams that are fed by springs. The dissolved constituents are predominantly calcium and bicarbonate, but the water is higher in dissolved solids and is saturated with respect to calcite.

AREAL VARIATIONS IN DISSOLVED CONSTITUENTS

Hydrochemical Facies

Hydrochemical facies is a term used to denote the diagnostic chemical aspect of ground-water solution occurring in hydrologic systems (Back, 1966). The facies reflect the response of chemical processes operating within the lithologic framework and the pattern of ground-water movement. The distribution of different facies within the Edwards aquifer can be used to locate the ground-water flow path and to estimate the relative rate of ground-water circulation.

The classification of hydrochemical facies is made through the use of a trilinear diagram (fig. 4). For purposes of this report the central diamond-shaped field of the diagram is equally subdivided into smaller diamond-shaped fields that are repeatedly subdivided until there are four levels of refinement. Then a lettering system is used to identify each quadrant and level of refinement. Each letter in a hydrochemical face indicates a quadrant and a level of refinement. The first letter represents the first level, the second letter represents the second level, etc. The quadrants are identified, with one exception at the second level, as "a" for the west quadrant, "b" for the north quadrant, etc.

The diagram on figure 4 shows the details with three levels of refinement, although four levels are commonly used. The plotting procedure for trilinear diagrams and the methods of geochemical analyses of water samples using the trilinear diagram are presented by Piper (1944).

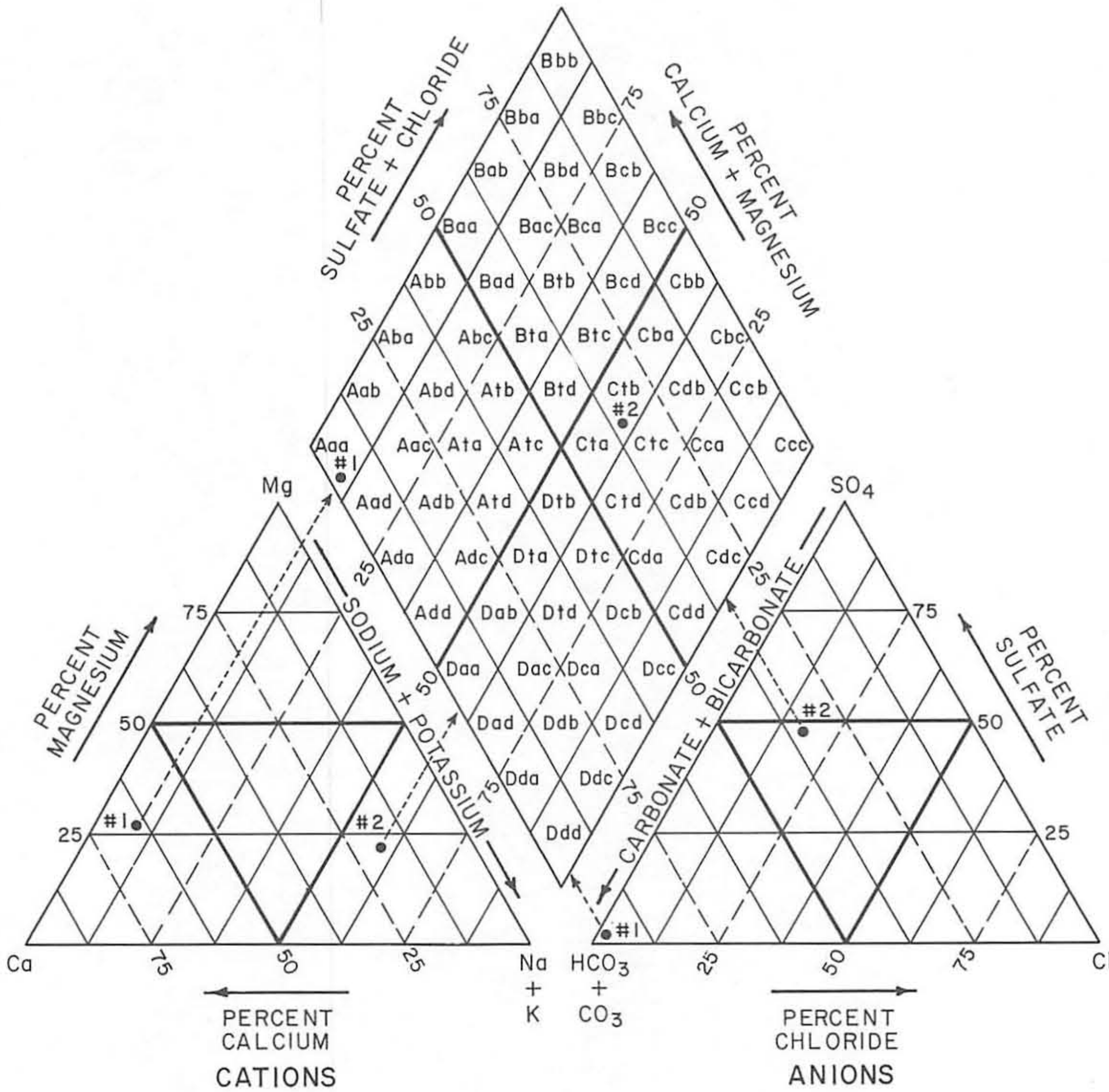
The areal distribution of hydrochemical facies of water in the Edwards aquifer in the San Antonio area is shown on figure 5. Typical water types and their corresponding hydrochemical facies are given in table 6. The relationship between hydrochemical facies and location within the aquifer system is also indicated in this table.

The hydrochemical face of water entering the aquifer is commonly Aaa. Face Aab is associated with the highly transmissive zone of the confined aquifer from which water is discharged by municipal wells in San Antonio and by Comal Springs. Hydrochemical facies Ab and Ba occur in areas removed from the probable main path of ground-water movement.

The normal sequence of hydrochemical facies for water in the aquifer from near the source of recharge to the saline zone is shown on figure 6. Hydrochemical facies that plot outside the normal transition pattern may be the result of mixing of water from aquifers other than the Edwards that has entered the well through leaky casing, of changes in the water chemistry between the time of sampling and chemical analyses, or of unknown reasons.

Dissolved Solids

The dissolved-solids concentration in ground water from the unconfined zone of the Edwards aquifer ranges from about 240 mg/L (milligrams per liter) in Kinney County to about 300 mg/L in Bexar, Comal, and Hays Counties. The concentration of dissolved solids in the confined freshwater zone ranges from about 250 mg/L in Kinney County to about 300 mg/L in Bexar, Comal, and Hays Counties (fig. 7). The dissolved-solids concentration in the eastern part



EXAMPLE

Water sample #1 – Aaad
Water sample #2–Ctbc

NOTE: Each letter of a hydrochemical facies indicates a quadrant and a level of refinement. The first letter represents the first level, the second letter represents the second level, etc. The quadrants are identified, with one exception, at the second level, as "a" for the west quadrant, "b" for the north quadrant, etc.

FIGURE 4.-Trilinear diagram to classify hydrochemical facies

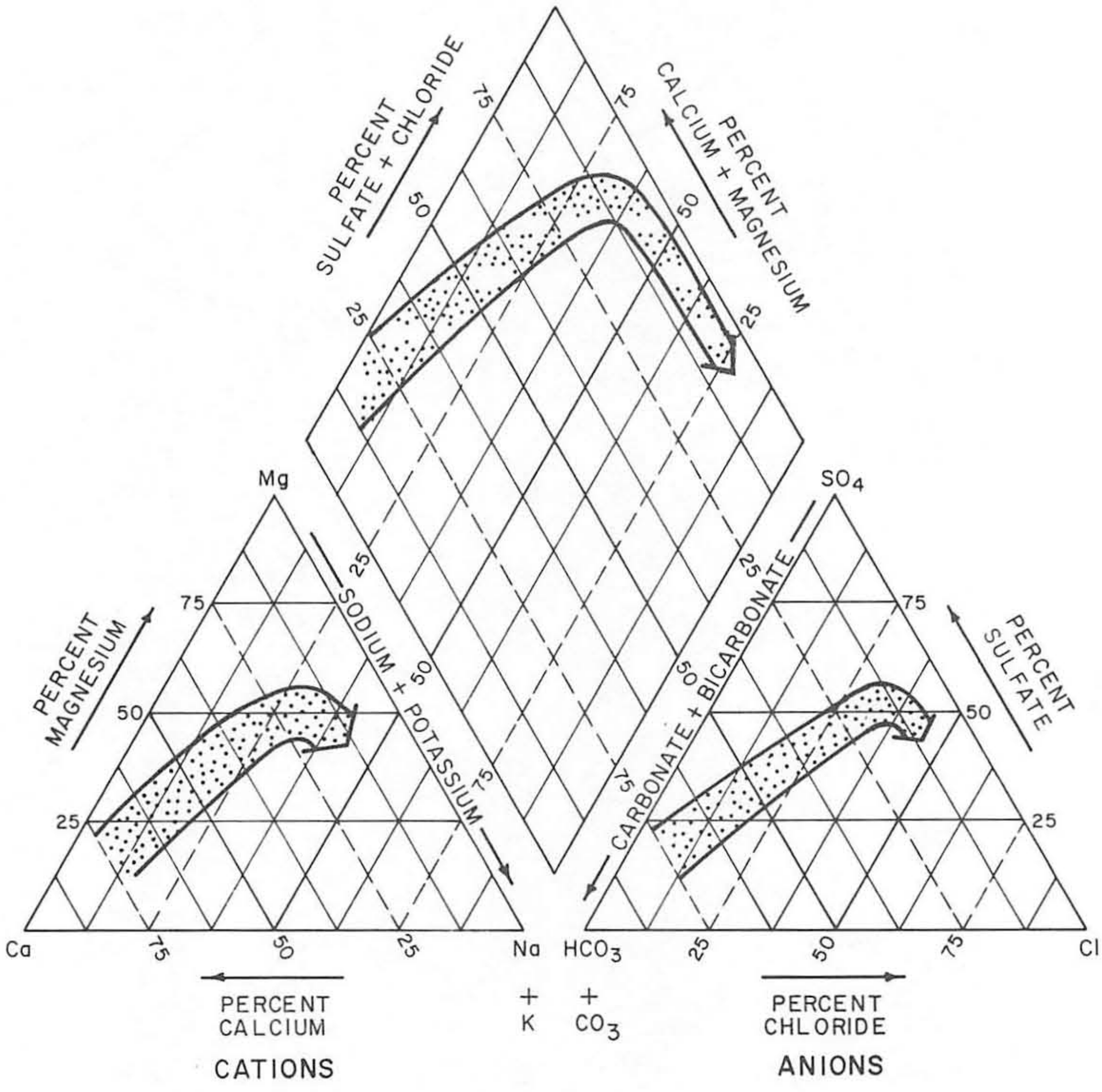


FIGURE 6.-Trilinear diagram of the normal sequence of hydrochemical facies from freshwater to saline water in the Edwards aquifer

of the area is slightly higher because more wells in the east obtain water from lower zones within the aquifer, which contain higher concentrations of dissolved solids. Locally, higher concentrations of dissolved solids within the confined freshwater zone occur in southeastern Uvalde County, in northeastern Medina County, in northwestern Bexar County, and in southeastern Hays County.

Near the bad-water line, the concentrations of dissolved solids increase rapidly from about 1,000 to about 9,000 mg/L. These values are considerably less than the salinity of water farther downdip in the aquifer because some freshwater is moving across the bad-water line and mixing with water in the saline zone.

Sulfate Concentrations

The sulfate concentrations in the freshwater zone of the Edwards aquifer are generally less than 20 mg/L; however, there are numerous exceptions (fig. 8). Sulfate concentrations in hydrochemical facies Aaca, Aaab, and Aabd are generally less than 15 mg/L, while hydrochemical facies Ab to Bb show concentrations of sulfate ranging up to several hundred mg/L.

Higher concentrations of sulfate occur in water from the stratigraphically lower part of the aquifer in the freshwater zone, and significantly higher sulfate concentrations occur in water from the freshwater zone near the bad-water line. Relatively high concentrations of sulfate in the freshwater zone occur in southeastern Uvalde County and northwestern Medina County. Ground-water circulation in these areas is believed to be slower than in areas where the water has lower concentrations of sulfate.

The sulfate concentration in the saline zone of the Edwards aquifer is considerably higher than that of any water sampled in the freshwater zone. Concentrations exceed 2,000 mg/L at locations only a few miles from the bad-water line. These high concentrations probably result from ground water dissolving gypsum and other sulfate-bearing minerals from the rocks within the saline zone.

TIME VARIATIONS IN WATER QUALITY

No significant long-term trend of changes in the chemical quality of ground water in the Edwards aquifer in the San Antonio area is apparent from the results of sampling from the 1930's to 1978. Time variations in the concentration of dissolved solids in ground water at selected wells and springs for 1966-76 are shown on figure 9.

The dissolved-solids concentration in water from springs show only small variations with time. This stability is an important indicator because the quality of springwater would reflect any major changes in chemical quality within the freshwater zone of the aquifer. Time variations in the dissolved-solids concentration of ground water in Kinney County is less than that of the counties to the east. Greater variations in the dissolved-solids concentration toward the east probably is the result of the mixing of waters entering the aquifer as water moves toward the regional discharge sites.

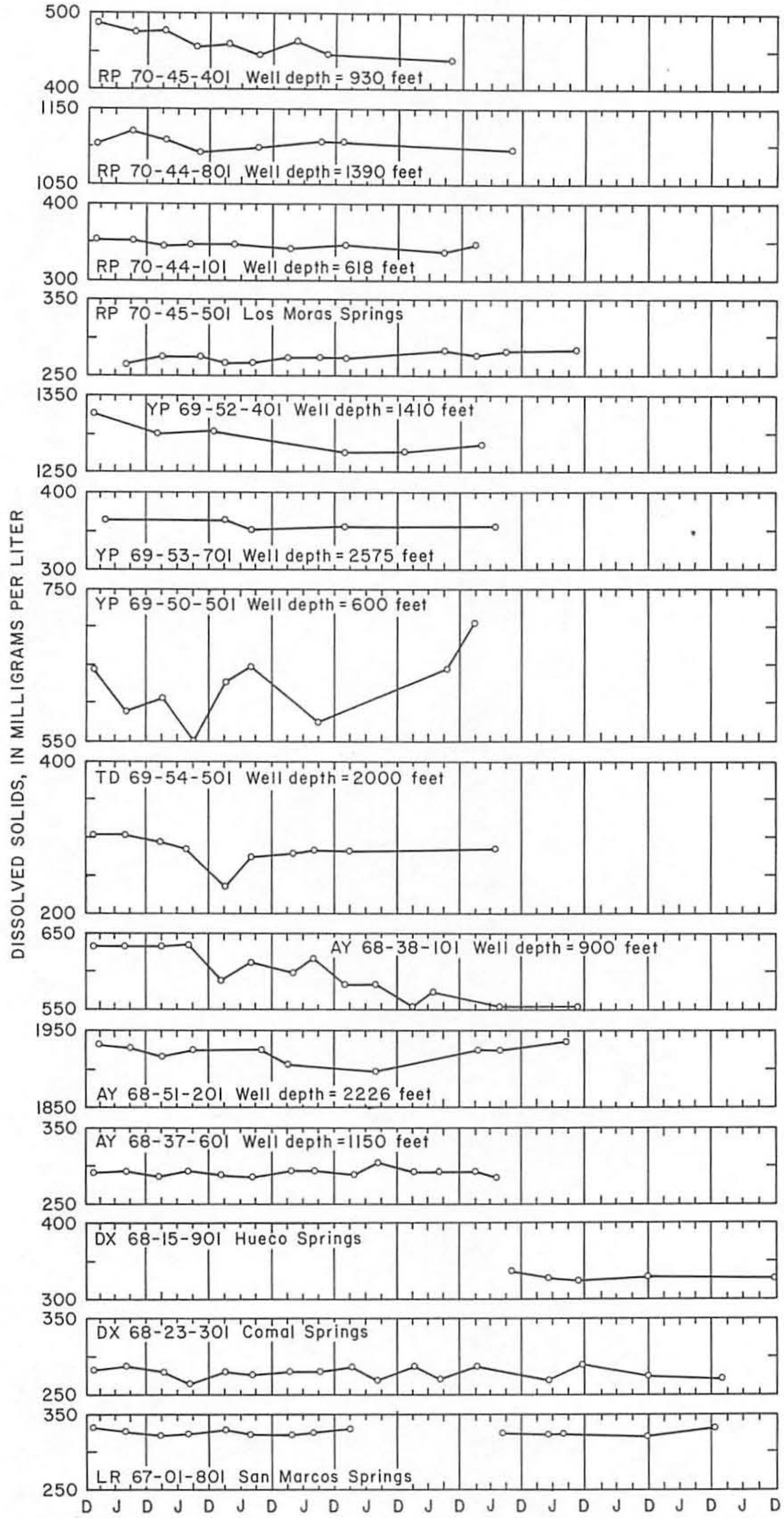


FIGURE 9.-Time variations in the chemical composition of water in the Edwards aquifer

To detect water movement in the vicinity of the bad-water line, selected wells have been repeatedly sampled since the 1930's. The mean concentrations of chloride together with the standard deviations, are shown on figure 10. A large standard deviation indicates a significant variation in the concentrations of chloride within the suite of samples. The greatest variation was detected in the vicinity of the bad-water line in Bexar County, where pumping stresses have changed the historic flow patterns.

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Table 1.--Chemical analyses of water samples from the Edwards aquifer

(Concentrations in milligrams per liter, except as indicated)

WELL NO.	DATE	DEPTH (FT)	DIS-SOLVED SILICA (SIO_2)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED CAL-CIUM (CA)	DIS-SOLVED MAGNE-SIUM (MG)	DIS-SOLVED STRON-TIUM (SR) (UG/L)	DIS-SOLVED SODIUM (NA)	SODIUM AD-SORP-TION RATIO (SAR)	PER-CENT SODIUM	DIS-SOLVED POTAS-SIUM (K)	BICAR-BONATE (HCO_3)	CAR-BONATE (CO_3)	DIS-SOLVED SUL-FATE (SO_4)	DIS-SOLVED CHLO-RIDE (CL)	DIS-SOLVED FLUO-RIDE (F)	TOTAL SUL-FIDE (H_2S)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS)	SPECIFIC CONDUCT-ANCE (MICRO-MHOS)	HARD-NESS (CA,MG)	NON-CARBON-ATE HARD-NESS	PH (UNITS)	TEM-PERA-TURE (°C)	REMARKS
ATASCOSA CO.																								
AL-68-50-201	7-22-70	--	16	--	83	32	34000	24	--	--	3.0	240	--	169	44	2.8	--	518	759	--	--	7.15	38.9	Lytle city well
AL-68-50-301	8- 4-77	--	13	--	69	20	--	16	0.4	12	1.7	240	0	62	28	.6	--	329	603	250	58	7.4	33.0	C. W. Mask
BEXAR CO.																								
AY-68-27-515	7-28-70	358	10	0	80	15	290	7.1	--	--	1.1	293	--	21	14	.2	--	297	505	--	--	7.20	22.4	Biering well (D-12)
AY-68-27-704	7-29-74	700	10	--	85	12	--	9	--	--	--	268	0	32	17	.3	--	303	507	263	--	7.6	23.0	Moos well, analysis by Tex. Dept. of Health
AY-68-29-104	3-23-72	602	13	0	110	21	840	5.8	.1	3	1.2	372	--	12	13	.2	--	361	596	360	51	6.9	23.0	Hill Country Water Works
AY-68-29-109	7-22-70	459	13	100	96	10	200	6.9	--	--	.8	340	--	7.8	14	.2	--	282	445	--	--	6.94	22.8	do. (F-169)
AY-68-29-702	3-22-72	872	12	0	89	14	400	7.4	.2	5	1.2	296	.00	23	14	.2	--	313	557	280	37	7.2	22.5	San Antonio City Water Board
AY-68-29-913	do.	784	13	0	70	15	540	8.0	--	--	1.3	260	.00	21	12	.2	--	274	483	240	23	7.2	25.0	do.
AY-68-30-102	7- 3-74	418	9	100	88	6	--	6	--	--	1.0	261	0	26	11	.2	--	277	460	245	--	7.6	23.0	Barrett Ind.
AY-68-30-219	3-23-72	850	14	0	94	17	550	12	.3	8	2.3	326	0	27	17	.3	--	359	617	300	38	7.0	22.0	Elmer Pape well
AY-68-30-801	4- 5-76	684	--	--	67	18	--	13	.4	10	1.4	242	0	33	22	--	--	--	507	240	43	7.8	27.5	Converse city well
AY-68-30-802	3-22-72	750	13	0	68	17	1600	13	.4	11	1.4	244	0	34	23	.3	--	294	511	240	40	7.35	27.5	do.
AY-68-30-803	4- 5-76	638	--	--	68	18	--	13	.4	10	1.5	244	0	34	22	--	--	--	508	240	44	7.5	25.5	Claude Ivey well
AY-68-30-805	do.	576	--	--	67	19	--	20	.6	15	1.6	242	0	35	35	--	--	--	547	250	47	7.4	27.0	O. A. Kneupper well
AY-68-30-807	9- 1-72 11-21-72	1202 1202	1.6 9.6	-- --	560 450	270 210	-- --	1200 880	10 8.5	50 49	-- --	312 270	.00 .00	1900 1500	2000 1500	-- 2.0	-- --	-- 4680	8710 6950	2503 2000	-- 1800	7.5 7.4	-- 29.0	USGS Randolph core test
AY-68-35-904	7- -71	676	12	0	63	16	800	7.5	--	--	1.2	246	--	15	11	.3	--	252	--	--	--	7.29	25.4	
AY-68-36-102	do.	787	11	0	79	16	500	8.2	--	--	1.4	290	--	29	14	.3	--	300	--	--	--	7.25	22.5	
AY-68-36-601	11-23-73	--	12	0	72	15	330	8.7	.2	7	1.4	256	--	20	14	.2	--	279	495	240	28	7.05	24.0	San Pedro Springs
AY-68-36-908	12- 7-73	1708	12	0	65	17	1300	8.3	.2	7	1.2	248	.00	23	15	.2	--	270	477	230	--	7.3	27.0	Bexar Metro. Water Dist.
AY-68-37-104	7-15-70	994	12	0	70	17	440	7.3	--	--	1.4	258	--	31	12	.3	--	275	457	--	--	7.2	22.4	San Antonio City Water Board
AY-68-37-115	11-23-73	--	14	10000	76	16	500	9.3	--	7	1.5	267	0	22	15	.2	--	295	513	260	31	7.1	24	San Antonio Springs
AY-68-37-202	3-22-72	702	12	0	66	15	940	7.8	.2	7	1.2	248	0	17	14	.2	--	261	461	230	23	7.4	25.5	Salado Water Co.
AY-68-37-503	3-15-76	1200	--	--	67	17	--	10	.3	8	1.3	242	0	27	17	--	--	--	478	240	39	7.5	26.0	Community water supply
AY-68-37-507	do.	1108	--	--	66	16	--	8.3	.2	7	1.1	244	0	20	15	--	--	--	460	230	31	7.4	27.0	San Antonio City Water Board
AY-68-37-602	1-30-73	1100	13	0	130	61	3900	150	2.7	35	8.6	255	--	320	260	2.1	--	1070	1770	590	380	7.2	28.0	Landis Lakes well
AY-68-37-603	3-15-76	797	--	--	83	23	--	35	.9	20	4.1	246	0	100	50	--	--	--	721	300	100	7.5	28.0	A. L. Wilson well

Table 1.--Chemical analyses of water samples from the Edwards aquifer--Continued

WELL NO.	DATE	DEPTH (FT)	DIS-SOLVED SILICA (SIO_2)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED CAL-CIUM (CA)	DIS-SOLVED MAGNE-SIUM (MG)	DIS-SOLVED STRON-TIUM (SR) (UG/L)	DIS-SOLVED SODIUM (NA)	SODIUM AD-SORP-TION RATIO (SAR)	PER-CENT SODIUM	DIS-SOLVED POTAS-SIUM (K)	BICAR-BONATE (HCO_3)	CAR-BONATE (CO_3)	DIS-SOLVED SUL-FATE (SO_4)	DIS-SOLVED CHLO-RIDE (CL)	DIS-SOLVED FLUO-RIDE (F)	TOTAL SUL-FIDE (H_2S)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS)	SPECIFIC CONDUCT-ANCE (MICRO-MHOS)	HARD-NESS (CA,MG)	NON-CARBON-ATE HARD-NESS	PH (UNITS)	TEM-PERA-TURE (°C)	REMARKS
AY-68-37-701	7-23-70 3-16-76	1582 1582	12 --	10 --	62 67	17 17	1700 --	8.9 9.0	-- 0.3	-- 8	-- 1.2	242 243	-- 0	25 23	15 16	0.4 --	-- --	267 --	431 475	-- 240	-- 38	7.2 7.5	27.4 27.0	San Antonio City Water Board (Cy-284)
AY-68-37-702	7- -70	2129	22	2700	460	213	14000	596	--	--	37	403	--	1440	1050	5.0	55	4100	--	--	--	6.8	28.0	
AY-68-37-703	3-15-76	1300	--	--	63	23	--	14	.4	11	1.3	248	0	51	23	--	--	--	538	250	49	7.4	28.0	Southern Henke Ice
AY-68-37-704	12- 7-73 3-16-76	1617 1617	12 --	0 --	66 64	22 21	9000 --	11 11	.3 .3	9 9	1.4 1.3	252 248	0 0	42 37	17 18	.8 --	1/ --	299 --	522 501	260 250	48 43	7.5 7.5	27.5 27.0	Lone Star Brewery
AY-68-37-706	12- 7-73 10- 7-74	-- 1521	12 --	400 --	70 65	20 17	1700 --	15 --	.4 --	11 --	1.7 --	246 244	0 0	49 46	25 23	-- --	-- --	318 --	555 515	260 230	56 32	7.10 7.5	27.0 28.0	San Antonio City Water Board Mission Sta. #6
AY-68-38-101	7- -71	902	8.6	6200	93	37	2900	95	--	--	7.7	238	--	195	147	1.2	.04	713	--	--	--	7.2	31.3	
AY-68-38-102	4- 7-76	775	--	--	52	25	--	20	.6	16	1.9	224	0	48	34	--	--	--	524	230	49	8.0	25.5	A. J. Brucks well
AY-68-38-103	3-15-76	884	--	--	130	53	--	180	3.4	41	12	230	0	320	310	--	--	--	1790	540	350	7.6	25.0	A. Y. Allison well
AY-68-38-301	7- -71 3-15-76	854 854	19 --	600 --	560 570	204 190	13000 --	953 950	-- 8.8	-- 48	62 53	320 305	-- 0	1880 1800	1560 1600	4.1 --	19 --	5440 --	-- 7330	-- 2200	-- 2000	6.69 6.9	32.0 32.0	Richard Schirmer well
AY-68-42-312	3-23-72	1368	13	0	68	14	820	7.5	.2	7	1.1	248	0	15	15	.2	--	263	459	230	24	7.25	25.0	Alamo Farms well
AY-68-42-804	do.	2301	12	0	63	16	3900	6.7	.2	6	1.1	242	0	18	13	.3	--	254	451	220	25	7.50	27.5	Kohlleppel Bros. well
AY-68-43-601	9- 4-73 4-15-76 6-20-77	1909 1909 1909	12 -- 12	10 -- 10	66 66 65	16 16 16	1400 -- --	8.2 9.0 8.7	.2 .3 --	7 8 8	1.3 1.2 1.1	244 245 240	0 0 0	21 22 23	17 16 18	.5 -- .3	-- -- --	266 -- 262	481 464 467	230 230 230	30 30 31	7.26 7.5 7.3	27.0 27.0 27.0	O. R. Mitchell well
AY-68-43-608	do.	1683	12	10	66	17	--	10	.3	8	1.2	240	0	30	19	.3	--	274	482	230	38	7.3	27.0	H. Verstraeten well
AY-68-43-610	5-24-76 3-28-77	1856 1856	-- 13	-- --	74 71	21 22	-- --	21 20	.6 .5	14 14	2.0 2.2	241 238	0 0	84 77	36 34	-- .5	-- --	568 357	-- 624	270 270	74 73	7.3 7.3	33.0 33.0	Knowlton Dairy well
AY-68-43-702	7-20-70	2054	18	350	210	61	6900	121	--	--	9.0	253	0	466	244	2.5	13	1280	1810	--	--	6.85	37.0	K. L. Haggard well
AY-68-43-703	7- -71	2031	17	150	196	59	7800	106	--	--	7.5	244	--	490	204	1.6	11	1220	--	--	--	7.02	35.8	
AY-68-43-807	4-15-76	--	--	--	92	26	--	30	.7	16	2.7	236	0	130	54	--	--	--	762	340	140	7.4	36.0	A. A. Grothues well
AY-68-43-809	7- -71	1903	14	100	112	34	5300	49	--	--	--	232	--	220	86	1.2	3.2	646	--	--	--	7.0	35.3	
AY-68-43-810	7-23-70	1860	14	50	100	37	7400	45	--	--	4.5	243	--	187	85	1.3	3.7	593	947	--	--	7.08	35.5	K. L. Haggard well
AY-68-43-812	5-24-76	1800	--	--	71	19	--	17	.5	13	1.8	242	0	67	28	--	--	--	561	260	57	7.3	32.0	A. A. Seligson well
AY-68-43-901	3-16-76	2274	--	--	350	120	--	230	2.7	27	[illegible]	259	0	960	500	--	--	--	3110	1400	1200	7.2	38.5	I. Ernst well
AY-68-44-210	7- -71	1673	13	510	111	40	4200	55	--	--	4.2	224	--	211	97	1.6	1.3	661	--	--	--	7.20	31.3	
AY-68-44-225	5-24-76	1376	--	--	64	17	--	9.8	.3	8	1.2	243	0	30	16	--	--	--	469	[illegible]	31	7.4	27.0	R. Aelvdet well
AY-68-44-301	12- 4-72	1373	7.8	0	70	17	1800	10	.3	8	1.5	246	0	36	16	.4	--	284	460	240	43	7.35	28.0	J. R. Reynolds well
AY-68-44-401	7-23-70	1532	12	0	62	17	1700	8.7	--	--	1.2	243	--	25	15	.4	--	267	448	--	--	7.20	27.4	Verstuyft well (N-6)
AY-68-44-404	7-20-70	1660	21	50	270	104	8900	188	--	--	14	280	--	730	376	3.5	22	1820	2480	--	--	7.00	30.8	Felipe Vargas well

See footnotes at end of table.

Table 1.--Chemical analyses of water samples from the Edwards aquifer--Continued

WELL NO.	DATE	DEPTH (FT)	DIS-SOLVED SILICA (SIO_2)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED CAL-CIUM (CA)	DIS-SOLVED MAGNE-SIUM (MG)	DIS-SOLVED STRON-TIUM (SR) (UG/L)	DIS-SOLVED SODIUM (NA)	SODIUM AD-SORP-TION RATIO (SAR)	PER-CENT SODIUM	DIS-SOLVED POTAS-SIUM (K)	BICAR-BONATE (HCO_3)	CAR-BONATE (CO_3)	DIS-SOLVED SUL-FATE (SO_4)	DIS-SOLVED CHLO-RIDE (CL)	DIS-SOLVED FLUO-RIDE (F)	TOTAL SUL-FIDE (H_2S)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS)	SPECIFIC CONDUCT-ANCE (MICRO-MHOS)	HARD-NESS (CA,MG)	NON-CARBON-ATE HARD-NESS	PH (UNITS)	TEM-PERA-TURE (°C)	REMARKS
AY-68-44-5	3-11-69	1850	--	--	--	172	--	--	--	--	--	314	0.00	1400	950	--	--	--	5290	--	--	6.9	41	J. W. Austin well (N-11)
	3-16-76	1850	--	--	540	170	--	470	4.5	33	27	348	0	1500	970	--	--	--	5060	2000	1800	6.9	41.5	
AY-68-45-101	7- -71	--	21	20	620	231	13000	449	--	--	28	292	--	2000	871	4.5	53	4430	--	--	--	6.67	39.0	Hot Wells Lodges well
	3-15-76	1875	--	--	640	230	--	440	3.8	27	32	292	0	1900	950	--	--	--	5560	2500	2300	6.8	40.0	
	7- 7-77	1875	22	--	590	230	14000	480	4.2	30	25	290	0	1800	870	3.5	--	4180	5380	2400	2200	6.6	39.0	
AY-68-45-102	7-17-70	--	22	2700	460	213	14000	596	--	--	37	403	--	1440	1050	5.0	--	3990	5060	--	--	6.80	32.2	Morrill School well
	4-16-76	--	--	--	500	210	--	550	5.2	36	25	404	0	1500	1000	--	--	--	5560	2100	1800	7.4	27.0	
AY-68-45-301	7-16-70	2172	24	50	620	212	15000	462	--	--	38	282	--	1850	934	5.0	50	4280	5020	--	--	6.65	42.4	Holt Machinery well
AY-68-45-302	7- 7-77	1715	23	--	610	210	14000	430	3.8	28	26	280	0	1800	910	3.4	--	4160	5500	2400	2200	6.7	38.5	Rudy Rivers well
AY-68-45-802	7-29-70	2444	24	10	620	214	14000	442	--	--	34	286	--	1780	940	5.0	63	4180	4850	--	--	6.50	47.2	Blue Wing Club (O-50)
	7- -71	2444	24	10	635	209	14000	455	--	--	27	282	--	1900	800	4.4	67	4270	--	--	--	6.60	47.0	
AY-68-45-901	1-30-73	2920	24	400	680	210	13000	340	3.0	23	17	258	--	2000	750	3.5	1/	4150	5190	2600	2300	6.60	48.0	City Public Service Board
AY-68-51-201	9- 4-73	2219	20	510	540	200	13000	350	3.3	26	19	276	0	1600	780	5.1	--	3660	4850	2200	2000	6.70	40.5	R. Aelvoet well
COMAL CO.																								
DX-68-15-901	10- 4-72	spring	11	0	97	15	--	7.5	.2	5	1.4	340	0	14	11	.2	--	336	592	300	20	7.0	22	Hueco Spring (50± ft^3/s)
	5-15-73	spring	10	0	110	10	210	7.2	.2	5	.1	330	0	16	14	.2	--	329	439	310	35	7.4	21	Manganese 0.00 ug/L
	11-23-73	spring	11	0	100	11	100	8.1	.2	5	1.4	335	0	14	13	.2	--	342	594	300	20	7.3	22	
	12-16-74	spring	10	1	97	13	310	7.4	.2	5	1.5	342	0	14	11	.2	--	330	539	300	16	6.6	21.5	
	1-14-76	spring	11	--	94	16	400	7.2	.2	5	1.3	345	0	14	12	.2	--	326	585	300	18	6.5	21.5	
DX-68-16-602	11- 8-72	--	15	0	790	410	17000	1500	--	46	62	453	0	2800	2800	2.5	--	8510	11700	3700	3300	6.65	24.0	Juan Arrendondo well
DX-68-16-701	4-13-76	432	12	--	83	21	730	7.9	.2	6	1.2	316	0	31	13	--	--	2/ 327	578	290	35	7.5	24.5	TWDB Gruene well
DX-68-22-301	7- 3-74	375	12	--	109	7	--	5	--	--	--	356	0	<4	9	.1	--	317	532	300	--	7.7	23.3	Henry Ludwig, analysis by Tex. Dept. of Health
DX-68-23-301	7- -71	spring	11	--	75	16	600	8.1	--	--	1.3	288	--	23	12	.3	--	289	--	--	--	7.26	23.4	Comal Springs
	5-15-73	spring	12	0	80	16	610	7.6	.2	6	1.2	283	0	25	14	.3	--	298	479	270	34	7.6	23.5	
	11-23-73	spring	12	0	79	17	500	8.1	.2	6	1.4	300	0	22	13	.2	--	309	528	270	21	7.5	24.0	
	12-16-74	spring	12	10	77	16	620	8.5	.2	7	1.6	283	0	23	14	.2	--	300	520	260	27	6.5	23.5	
	1-14-76	spring	12	--	81	17	550	8.3	.2	6	1.3	294	0	20	13	.2	--	298	532	270	32	6.5	23.5	
DX-68-23-706	5-23-75	450	11	--	87	51	--	160	3.4	43	21	273	0	210	280	2.7	--	957	1660	430	200	8.0	24.5	
DX-68-23-707	7- 7-77	450	12	0	8.8	67	10000	140	2.7	37	13	520	0	95	230	3.6	--	--	1560	510	80	7.0	23.5	Homecraft well
DX-68-23-807	10- 4-72	515	11	980	150	120	210	450	--	--	24	396	0	540	740	3.0	--	2250	3560	870	540	7.7	24.0	Emil Feick well
GUADALUPE CO.																								
KX-68-30-312	7- -71	197	12	0	74	17	500	8.5	--	--	1.5	264	--	29	13	.3	--	290	--	--	--	7.15	24.4	R. E. Schertz
	2- 4-75	645?	--	--	85	21	--	--	--	--	--	284	0	51	34	--	--	323	616	270	41	7.6	23.0	
	12- 5-76	645?	15	--	78	23	--	35	.9	2.1	3.8	286	0	61	40	.8	--	398	688	290	55	7.4	23.5	
KX-68-30-601	7- -71	565	13	700	188	110	21000	329	--	--	19	282	--	619	552	3.9	6.6	2000	--	--	--	7.12	25.2	W. Kramer
	7- 7-77	565	14	--	190	110	20000	330	4.7	43	18	280	0	580	580	3.3	--	1980	3060	950	720	7.1	24.0	

See footnotes at end of table.

Table 1.--Chemical analyses of water samples from the Edwards aquifer--Continued

WELL NO.	DATE	DEPTH (FT)	DIS-SOLVED SILICA (SIO_2)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED CAL-CIUM (CA)	DIS-SOLVED MAGNE-SIUM (MG)	DIS-SOLVED STRON-TIUM (SR) (UG/L)	DIS-SOLVED SODIUM (NA)	SODIUM AD-SORP-TION RATIO (SAR)	PER-CENT SODIUM	DIS-SOLVED POTAS-SIUM (K)	BICAR-BONATE (HCO_3)	CAR-BONATE (CO_3)	DIS-SOLVED SUL-FATE (SO_4)	DIS-SOLVED CHLO-RIDE (CL)	DIS-SOLVED FLUO-RIDE (F)	TOTAL SUL-FIDE (H_2S)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS)	SPECIFIC CONDUCT-ANCE (MICRO-MHOS)	HARD-NESS (CA,MG)	NON-CARBON-ATE HARD-NESS	PH (UNITS)	TEM-PERA-TURE (°C)	REMARKS
<u>HAYS CO.</u>																								
LR-67-01-801	3- 7-73	spring	11	10	84	18	--	10	0.03	7	1.6	305	0	26	19	0.3	--	327	633	280	31	7.10	22	San Marcos Spring, manganese 0.00 ug/L
	5-15-73	spring	11	0	86	17	610	9.6	.2	7	1.4	306	--	25	20	.2	0.00	325	507	280	34	7.20	22	Manganese 0.00 ug/L
	1-14-76	spring	11	--	85	19	540	9.7	.2	7	1.5	320	0	19	18	.1	--	322	585	290	29	6.4	22	
LR-67-16-603	7- 3-74	200	10	0	101	34	--	54	.2	7	1.4	182	0	81	89	2.1	--	550	1085	606	--	7.8		Analysis by State of Tex.
<u>KINNEY CO.</u>																								
RP-70-37-8__	1-16-75	spring	12	10	82	2.7	310	6.7	.2	6	1.2	238	0	6.4	10	.1	--	3/ 249	414	220	21	7.3	19.5	Pinto Springs (O-1)
RP-70-44-801	10-11-72	1390	16	80	680	55	9400	13	.1	1	2.8	--	226	1700	7.1	2.3	--	2570	2600	1900	1700	6.70	33.5	W. A. Richards (V-14)
RP-70-45-501	10-10-72	spring	11	0	78	6.2	120	5.6	.2	5	1.2	247	0	7.2	9.6	.1	--	249	--	220	18	7.25	24.0	Las Moras Springs
	2-20-73	spring	11	0	77	6.6	200	5.4	--	--	.8	229	0	6.6	11	.2	--	242	392	220	32	7.40	22.0	
	10-31-73	spring	11	--	80	5.5	--	4/ 4.7	.1	--	--	240	0	7.6	10	.1	--	254	449	220	26	6.9	23.0	
	7- 9-74	spring	11	10	75	6.1	160	5.5	.2	5	.8	239	0	8.2	11	.1	--	3/ 245	423	210	17	7.0	23.5	
	1-16-75	spring	10	0	71	6.9	170	5.5	.2	5	1.1	237	0	6.8	11	.1	--	3/ 240	402	210	12	7.1	21.5	
	1-16-76	spring	10	--	74	6.7	150	5.4	.2	5	.7	248	0	4.3	10	.1	--	3/ 234	429	210	9	6.3	22.0	
RP-70-45-601	10-10-72	1481	6.5	0	79	5.8	3500	6.2	.2	6	1.3	249	0	14	9.7	.4	--	249	460	220	17	7.0	25.5	City of Brackettville
<u>MEDINA CO.</u>																								
TD-68-33-101	7-10-74	350	10	--	70	13	--	6	--	--	--	227	0	36	12	.2	--	261	434	231	--	7.7	--	Holshouse & Boehm, analysis by Tex. Dept. of Health
TD-68-34-103	8- 2-72	1015	11	10	66	19	740	6.8	.2	6	1.4	242	0	50	12	.4	--	285	499	240	49	7.35	23.0	Wurzbach
TD-68-41-303	7- -71	715	12	0	67	15	500	7.8	--	--	1.2	250	--	14	14	.2	--	259	--	--	--	7.20	24.5	City of Castroville
TD-68-41-401	8- -72	1972	12	10	75	14	1100	7.2	--	--	1.1	258	--	12	26	.3	--	279	--	--	--	7.45	25.0	Podevyn
TD-68-41-801	7-27-70	1608	12	1900	42	22	3000	38.0	--	--	2.5	266	--	10	35	3.3	.045	299	510	--	--	7.62	23.8	Elmo Butler
TD-68-42-503	8- 2-72	1373	12	10	60	15	1400	6.9	.2	7	1.1	244	0	13	12	.3	--	245	442	210	13	7.05	26.0	LaCoste city well
TD-68-42-806	7- -71	2044	14	0	56	15	2000	7.2	--	--	1.0	224	--	15	14	1.8	--	238	--	--	--	7.30	33.6	Lytle city well
TD-68-49-813	3-12-73	3200	23	40	81	27	38000	43	1.1	21	3.9	228	0	170	63	4.2	--	562	865	310	130	7.35	46.0	USGS Devine core test, pumped lower interval (2800-3200 feet) only, entire Edwards (2600-3200 feet) tested
	3-14-73	3200	23	80	80	27	41000	33	--	--	3.5	228	0	170	50	4.4	--	544	821	310	120	7.15	44.0	
	11-20-73	3200	--	--	80	25	--	--	--	--	--	312	0	78	150	--	--	--	1120	300	4.7	7.6		
	8- 4-77	3200	23	--	60	23	--	130	3.6	53	7.0	350	0	41	170	4.6	--	631	1140	240	--	7.4	41.5	
TD-69-38-102	7-10-74	400	10	--	68	11	--	6	--	--	--	226	0	18	12	.2	--	244	409	217	--	7.6	--	E. L. Kelly, analysis by Tex. Dept. of Health
TD-69-38-601	6- 5-75	538	11	2	73	12	260	6.5	.2	6	.8	239	0	18	11	.1	--	257	436	230	36	6.8	--	
TD-69-39-501	2-22-74	680	12	0	74	11	100	7.4	.2	6	1.2	249	0	11	13	.2	--	276	472	230	26	7.01	23.0	Gilliam Farms
TD-69-39-801	6- 5-75	863	11	--	72	11	--	5.3	.2	5	1.0	243	0	13	9.4	.2	--	243	428	230	26	7.5	23.0	E. Saathoff
TD-69-40-901	7-28-70	1217	12	10	69	11	240	5.6	--	--	1.0	249	--	22	10	.2	--	254	--	--	--	7.02	23.4	Fritz Folis (J-1-44)

See footnotes at end of table.

Table 1.--Chemical analyses of water samples from the Edwards aquifer--Continued

WELL NO.	DATE	DEPTH (FT)	DIS-SOLVED SILICA (SIO_2)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED CAL-CIUM (CA)	DIS-SOLVED MAGNE-SIUM (MG)	DIS-SOLVED STRON-TIUM (SR) (UG/L)	DIS-SOLVED SODIUM (NA)	SODIUM AD-SORP-TION RATIO (SAR)	PER-CENT SODIUM	DIS-SOLVED POTAS-SIUM (K)	BICAR-BONATE (HCO_3)	CAR-BONATE (CO_3)	DIS-SOLVED SUL-FATE (SO_4)	DIS-SOLVED CHLO-RIDE (CL)	DIS-SOLVED FLUO-RIDE (F)	TOTAL SUL-FIDE (H_2S)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS)	SPECIFIC CONDUCT-ANCE (MICRO-MHOS)	HARD-NESS (CA,MG)	NON-CARBON-ATE HARD-NESS	PH (UNITS)	TEM-PERA-TURE (°C)	REMARKS
TD-69-46-402	4-25-72	1982	12	0	66	15	350	7.2	0.2	6	1.1	248	0	17	15	0.2	--	262	464	230	23	7.45	23.5	Clary Bros.
TD-69-46-601	do.	1289	12	0	70	14	330	6.8	.2	6	1.0	256	0	16	14	.2	--	266	471	230	22	7.21	24.0	D'Hanis city well
TD-69-46-903	do.	--	12	10	71	14	530	9.2	.3	8	1.0	247	0	15	19	.2	--	273	488	234	32	7.15	23.5	McCullough
TD-69-47-301	7-27-70	1509	12	0	64	15	280	6.6	--	--	1.2	253	--	16	12	.3	--	255	433	--	--	7.00	25.2	Hondo city well (I-3-117)
	7- -71	1509	12	0	65	16	300	6.8	--	--	1.2	256	--	16	12	.2	--	256	--	--	--	7.30	24.8	
TD-69-47-501	10-30-73	1659	12	10	69	16	500	6.5	.2	6	1.2	249	0	16	15	.3	--	268	466	240	34	7.25	23.5	Cyril VanDamme
TD-69-48-102	4-25-72	1654	12	10	62	17	750	7.0	.2	6	1.1	248	0	17	13	.3	--	257	473	220	21	7.40	26.0	Frank Muennink
TD-69-48-202	5-29-75	1717	13	150	56	19	3400	8.8	.3	8	1.1	240	0	19	13	.5	--	256	435	220	25	6.8	28.5	James Riff
TD-69-54-401	2-14-75	2000	11	20	59	16	1700	8.0	.2	8	.6	242	0	16	15	.4	--	252	455	220	17	7.2	24.5	G. E. Farley
TD-69-54-902	7- 6-73	2670	13	330	88	26	25000	[4]28	.7	16	--	282	0	64	60	1.5	--	420	707	330	96	7.4	--	Cecil Tindall
TD-69-55-701	1-15-76	--	13	--	71	18	7100	7.1	.2	6	1.0	254	0	21	29	.5	--	293	532	260	51	7.0	31	Senesa Ranch
UVALDE CO.																								
YP-69-35-902	7-10-74	847	12	--	81	20	--	10	--	--	--	226	0	16	66	.1	--	327	573	286	--	7.7	--	W. A. Seidel, analysis by Tex. Dept. of Health
	1-15-75	847	13	10	87	21	430	11	.3	7	1.4	224	0	16	84	.1	--	[3]356	641	300	120	7.0	22.5	
YP-69-41-701	7- 9-74	593	17	--	136	4	--	17	--	--	--	397	0	13	20	.2	--	424	--	359	--	7.3	--	Hilmer Martin, analysis by Tex. Dept. of Health
YP-69-43-102	10-11-72	685	7.7	0	73	15	270	6.9	.2	6	1.3	252	0	12	17	.1	--	263	425	240	37	7.35	22.5	Dolph Briscoe
YP-69-43-107	2-22-74	878	11	20	70	13	400	6.4	.2	6	.9	247	0	11	13	.1	--	261	463	230	26	7.15	22.5	Frasher Ranch
YP-69-43-603	7- 8-74	1373	16	390	67	15	49000	13	.4	11	2.1	224	0	110	9.8	3.1	--	[3]396	591	290	100	7.0	31.5	City of Knippa
YP-69-43-906	2-11-74	850	15	--	220	3.6	--	[4]160	3.0	39	--	244	0	170	360	.6	--	1100	1830	560	360	7.2	--	C. Zinsmeister
YP-69-43-908	4-26-72	1010	15	40	310	49	4300	130	1.8	22	3.0	246	0	180	600	.3	--	1460	2560	980	770	6.90	24.0	T. M. Woodley
YP-69-43-909	10-30-73	1305	13	60	140	30	5200	48	1.0	18	3.9	252	0	170	140	.9	--	664	1110	460	260	7.08	28.5	Clint Bratcher
YP-69-44-101	2-20-73	561	13	0	64	15	400	7.0	.2	6	1.1	229	0	11	19	.2	--	253	448	220	34	7.35	22.0	John Dodson
YP-69-44-103	7- 8-74	675	13	20	78	10	290	7.9	.2	7	1.1	247	0	11	23	.1	--	[3]275	482	240	33	7.0	24.5	Bruce Bishop
YP-69-44-502	4-26-72	1380	12	0	71	14	4800	9.2	.3	8	1.1	246	0	21	23	.4	--	282	494	230	33	7.25	29.5	Ed Falkenburg
YP-69-45-404	7- -71	1493	12	--	77	22	700	19	--	--	2.7	256	--	83	18	.4	--	369	--	--	--	7.30	23.4	(I-4-37)
YP-69-45-704	10-11-72	1655	9.0	0	76	13	280	8.2	.2	7	1.3	257	0	12	19	.2	--	272	445	240	32	7.35	23.5	W. Wiebolt
YP-69-50-101	7- -71	98	12	240	80	9.5	200	8.1	--	--	1.1	262	0	10	17	.2	--	273	--	--	--	7.20	23.6	
YP-69-50-105	10-10-72	955	7.6	0	94	11	310	9.2	.2	7	1.5	248	0	15	45	.2	--	312	562	280	--	7.15	24.0	R. K. Dunbar
YP-69-50-402	1-15-75	--	15	290	200	22	3800	25	.4	8	2.2	244	0	320	78	1.2	--	[3]789	1150	590	390	6.7	27.5	U.S. Fish & Wildlife
YP-69-51-103	4-26-72	503	17	10	120	15	4700	18	.4	10	1.8	288	0	110	29	.7	--	458	726	350	120	7.0	25.5	Garvis Marsh
YP-69-51-401	do.	400	14	50	120	12	2000	29	.7	15	1.5	296	0	59	73	.4	--	471	--	350	100	6.98	25.0	J. R. Carnes

See footnotes at end of table.

Table 1.--Chemical analyses of water samples from the Edwards aquifer--Continued

WELL NO.	DATE	DEPTH (FT)	DIS-SOLVED SILICA (SIO_2)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED CAL-CIUM (CA)	DIS-SOLVED MAGNE-SIUM (MG)	DIS-SOLVED STRON-TIUM (SR) (UG/L)	DIS-SOLVED SODIUM (NA)	SODIUM AD-SORP-TION RATIO (SAR)	PER-CENT SODIUM	DIS-SOLVED POTAS-SIUM (K)	BICAR-BONATE (HCO_3)	CAR-BONATE (CO_3)	DIS-SOLVED SUL-FATE (SO_4)	DIS-SOLVED CHLO-RIDE (CL)	DIS-SOLVED FLUO-RIDE (F)	TOTAL SUL-FIDE (H_2S)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS)	SPECIFIC CONDUCT-ANCE (MICRO-MHOS)	HARD-NESS (CA,MG)	NON-CARBON-ATE HARD-NESS	PH (UNITS)	TEM-PERA-TURE (°C)	REMARKS
YP-69-51-501	10-19-72	1050	7.2	--	220	110	--	4/430	5.9	48	--	328	0	990	450	3.1	--	2380	3320	1000	730	7.0	--	La Moca Ranch
YP-69-52-402	2-12-74	1262	18	--	220	7.6	--	4/520	9.4	66	--	322	0	830	410	2.8	--	2170	3100	580	320	7.2	--	Pat Johnson
YP-69-53-701	7- 9-74	2575	14	--	86	23	--	15	--	--	--	224	0	114	28	3.2	--	393	--	310	--	7.7	--	T. M. Woodley, analysis by Tex. Dept. of Health
YP-69-53-703	4-25-72	1990	14	320	92	23	24000	28	.7	16	2.2	232	0	130	50	3.7	--	484	763	320	130	7.15	36.0	Fred Woodley
YP-70-56-201	10-11-72	120	21	0	130	4.8	310	17	.4	9	2.7	390	0	18	24	.2	--	425	--	--	--	6.80	24.0	R. A. Rogers
ZAVALA CO.																								
ZX-69-61-526	3-28-75	--	19	150	660	120	13000	190	1.8	16	13	230	0	1800	370	3.0	1/	3300	3920	2200	2000	6.20	46.5	

1/ Sulfide odor noticed at time of sampling, no analysis made.
2/ Calculated
3/ Residual dissolved calcium.
4/ Sodium plus potassium.

Table 2.--Tabulation of published reports containing significant amounts of data on the water chemistry of the Edwards aquifer

Reference	Dissolved constituents or chemical parameter determined	Areal distribution of sampling sites	Remarks
Petitt and George, vol. II, pt. III (1956)	Ca, Mg, Na+K, HCO_3, SO_4, Cl, F, NO_3, TDS, and total hardness as $CaCO_3$	Kinney County--about 120 analyses of water from 120 wells and springs tapping the Edwards aquifer.	Chemical analyses are used primarily to determine the chemical suitability of the water for different uses.
	SiO_2, Fe, Ca, Mg, Na+K, HCO_3, SO_4, Cl, F, NO_3, B, TDS, hardness as $CaCO_3$, percent sodium, specific conductance, pH	Uvalde County--about 25 samples of water from 25 wells and springs tapping the Edwards aquifer.	do.
	do.	Medina County--138 analyses of water from 138 wells and springs tapping the Edwards aquifer.	do.
	do.	Bexar County--about 110 analyses of water from 100 wells and springs tapping the Edwards aquifer.	do.
	do.	Hays County--about 200 analyses.	do.
	Ca, Mg, Na+K (calculated), HCO_3, SO_4, Cl, NO_3, total hardness as $CaCO_3$ (calculated)	Comal County--about 160 analyses of water from about 120 wells and springs tapping the Edwards aquifer.	do.
Garza (1962)	HCO_3, SO_4, Cl, TDS, hardness as $CaCO_3$, specific conductance, pH	About 700 analyses of water from 129 wells located in the vicinity of the bad-water line. Sampling period 1959-62.	Water samples were obtained from the zone of transition between water of good quality and saline water in the Edwards aquifer, in order to detect changes in quality of the water as the head in the aquifer changed.
Garza (1964)	do.	About 170 analyses of water from 100 wells located in the vicinity of the bad-water line. Sampling period 1963.	do.
Garza (1965)	do.	About 130 analyses of water from 80 wells located in the vicinity of the bad-water line. Sampling period 1964.	do.
Garza (1966)	do.	About 90 analyses of water from 72 wells located in the vicinity of the bad-water line.	do.
Rettman (1967)	do.	About 70 analyses of water from 37 wells located in the vicinity of the bad-water line.	do.
Rettman (1968)	do.	do.	do.

Table 2.--Tabulation of published reports containing significant amounts of data on the water chemistry of the Edwards aquifer--Continued

Reference	Dissolved constituents or chemical parameter determined	Areal distribution of sampling sites	Remarks
Reeves and others (1972)	SiO_2, Ca, Mg, Na, K, HCO_3, CO_3, SO_4, Cl, F, Br, I, hardness as $CaCO_3$, SAR, specific conductance, pH, temperature, dissolved solids (calculated), NH_4, NO_2, NO_3, PO_4, detergents (MBAS), BOD, coliform, fecal coliform, streptococci, Al, As, B, Cu, Fe, Pb, Li, Mn, Ha, Zn	Uvalde, Medina, Bexar, Comal, and Hays Counties. Most water samples are taken from wells in or near the recharge area of the Edwards aquifer. Analyses of water from recharging streams were also made. About 240 well-water samples were obtained at 60 wells. About 42 surface-water samples were obtained at 34 sites. The water samples were collected during the period from August 1968 to April 1972. Analyses of water samples from 12 wells and 7 surface sites were made for pesticides.	Analyses are used to determine the suitability of the water for domestic use. Water samples are collected to establish background information on the chemical and bacteriological quality and to detect changes in water quality. Special efforts were made to insure that no contamination of samples resulted from sampling procedures. Values of some of the constituents or chemical parameters were not determined in many samples. Water was sampled from wells after pumping in order to obtain a representative sample of the water in the formation.
Reeves (1976)	SiO_2, Ca, Mg, Na, Na+K, K, HCO_3, CO_3, SO_4, CL, I, total nitrite plus nitrate, ammonia nitrogen, P, dissolved solids, hardness (Ca, Mg), noncarbonate hardness, percent sodium, SAR, specific conductance, pH, temperature, BOD, immediate coliform, fecal coliform, streptococci, C, methylene blue active substances, analyses for pesticides.	More than 900 analyses of water samples from 161 wells and 3 springs in the Edwards aquifer and from 36 sites on streams that cross the recharge zone of the aquifer. The water samples were collected during the period from August 1968 to January 1975.	do.
Reeves (1978)	do.	About 200 analyses of water samples from 79 wells and 3 springs in the Edwards aquifer collected from February 1975 through September 1977.	
Pearson and Rettman (1976)	Ca, Mg, Sr, Na, K, HCO_3, SO_4, Cl, F, PO_4, H_2S, SiO_2, Fe, total solids, pH, redox potential; carbon isotopes - ^{14}C, $\delta^{13}C$; sulfur isotopes - sulfate $\delta^{34}S$-, sulfide $\delta^{34}S$-; tritium; saturation indices - calcite, dolomite, gypsum, celestite, strontianite, fluorite	Samples taken from 89 widely distributed sampling points throughout the Edwards aquifer from Kinney to Hays Counties.	High quality analyses, field-determined pH, alkalinity, redox potential.
Pearson, Rettman, and Wyerman (1975)	tritium concentrations	Samples from 50 wells and springs widely distributed throughout the San Antonio area.	High quality analyses. Accurate results of low concentrations of a few tritium units.

Table 3.--Tritium concentrations in water from wells and springs in the Edwards aquifer

(Depths in feet; concentrations in tritium units ± 1 standard deviation.)

ATASCOSA COUNTY

WELL: AL-68-50-201

DATE	CONCENTRATION
10-29-68	0.4 ± 0.2

BEXAR COUNTY

WELL: AY-68-22-702

DATE	CONCENTRATION
10- 9-75	12.5 ± .7

WELL: AY-68-27-515

DATE	CONCENTRATION
4-10-67	45.8 ± 2.5
4- 8-69	44.4 ± 2.4
4-14-70	42.8 ± 2.4

WELL: AY-68-29-109
DEPTH OF WELL: 460
DEPTH OF CASING: 190

DATE	CONCENTRATION
4-21-69	6.1 ± .8
3-25-70	5.4 ± .4

WELL: AY-68-29-403
DEPTH OF WELL: 340
DEPTH OF CASING: 248

DATE	CONCENTRATION
11- 4-68	.5 ± .3
5- 5-69	1.2 ± .3

WELL: AY-68-30-103
DEPTH OF WELL: 841
DEPTH OF CASING: 435

DATE	CONCENTRATION
6- 3-68	5.2 ± .4

BEXAR COUNTY--Cont.

WELL: AY-68-34-601
DEPTH OF WELL: 395
DEPTH OF CASING: 198

DATE	CONCENTRATION
7-20-77	8.7 ± 0.5

WELL: AY-68-35-102

DATE	CONCENTRATION
6-21-78	16.0 ± .5

WELL: AY-68-35-904
DEPTH OF WELL: 675
DEPTH OF CASING: 612

DATE	CONCENTRATION
7-19-71	1.9 ± .7

WELL: AY-68-36-102
DEPTH OF WELL: 786
DEPTH OF CASING: 338

DATE	CONCENTRATION
7-30-71	13.9 ± .8

WELL: AY-68-36-601

DATE	CONCENTRATION
1- 6-78	4.2 ± .2

WELL: AY-68-37-104
DEPTH OF WELL: 995
DEPTH OF CASING: 570

DATE	CONCENTRATION
5-15-68	4.4 ± .3

WELL: AY-68-37-115

DATE	CONCENTRATION
1-31-78	3.4 ± .2

BEXAR COUNTY--Cont.

WELL: AY-68-37-701
DEPTH OF WELL: 1582
DEPTH OF CASING: 1275

DATE	CONCENTRATION
8-12-63	0.6 ± 0.4
11-20-64	.5 ± .5
3-10-67	2.9 ± .4
4- 1-68	4.7 ± .3
3- 7-69	.5 ± .1
4- 2-70	.6 ± .4
4-27-71	5.4 ± .4
6- 6-74	.8 ± .2
4- 6-76	1.3 ± .2

WELL: AY-68-42-210
DEPTH OF WELL: 1200
DEPTH OF CASING: 882

DATE	CONCENTRATION
8-12-63	1.2 ± .3
8-13-64	1.6 ± .3
5- 9-67	1.7 ± .4
5-22-68	1.3 ± .3
5-28-69	2.2 ± .3
6-19-70	1.9 ± .4
5- 6-75	3.6 ± .3
10- 6-76	4.1 ± .3

WELL: AY-68-42-212
DEPTH OF WELL: 985

DATE	CONCENTRATION
2-19-64	1.6 ± .2

WELL: AY-68-44-210
DEPTH OF WELL: 1672
DEPTH OF CASING: 1422

DATE	CONCENTRATION
7-21-71	.4 ± .6
10-14-75	2.0 ± .3

Table 3.--Tritium concentrations in water from wells and springs in the Edwards aquifer--Continued

BEXAR COUNTY--Cont.

WELL: AY-68-44-404
DEPTH OF WELL: 1660
DEPTH OF CASING: 1660

DATE	CONCENTRATION
10-14-71	2.0 ± 0.3

WELL: AY-68-45-102
DEPTH OF WELL: 2103
DEPTH OF CASING: 1200

DATE	CONCENTRATION
7-17-70	.1 ± .3

WELL: AY-68-45-301
DEPTH OF WELL: 2172
DEPTH OF CASING: 1750

DATE	CONCENTRATION
11-13-68	.0 ± .2

WELL: AY-68-45-302
DEPTH OF WELL: 1707
DEPTH OF CASING: 1555

DATE	CONCENTRATION
9-17-75	.0 ± .2

WELL: AY-68-45-901
DEPTH OF WELL: 2920
DEPTH OF CASING: 2492

DATE	CONCENTRATION
9-17-75	.5 ± .2

COMAL COUNTY

SPRING: DX-68-15-901

DATE	CONCENTRATION
8- 4-67	39.3 ± 3.9
3-13-68	60.0 ± 3.4
4- 6-70	54.2 ± 2.9
4-29-77	22.0 ± 1.2
4-25-78	15.9 ± 1.0

COMAL COUNTY--Cont.

WELL DX-68-16-502
DEPTH OF WELL: 230
DEPTH OF CASING: 160

DATE	CONCENTRATION
11-21-68	11.5 ± 0.7
5- 1-75	6.0 ± .4
8- 9-76	10.9 ± .6

WELL DX-68-16-701
DEPTH OF WELL: 432
DEPTH OF CASING: 20

DATE	CONCENTRATION
4-13-76	9.5 ± .5

WELL: DX-68-16-802
DEPTH OF WELL: 190
DEPTH OF CASING: 126

DATE	CONCENTRATION
12-16-68	12.7 ± .8
4-21-75	9.0 ± .5

WELL: DX-68-22-301
DEPTH OF WELL: 375
DEPTH OF CASING: 220

DATE	CONCENTRATION
4-16-69	51.6 ± 3.8
4- 2-75	13.9 ± 1.1

WELL: DX-68-22-501
DEPTH OF WELL: 498
DEPTH OF CASING: 95

DATE	CONCENTRATION
7- 8-75	3.9 ± .4
7-24-76	5.8 ± .4

WELL: DX-68-22-801
DEPTH OF WELL: 400
DEPTH OF CASING: 198

DATE	CONCENTRATION
5-19-70	20.7 ± 4.1
4- 2-75	17.0 ± .8

COMAL COUNTY--Cont.

WELL: DX-68-22-802
DEPTH OF WELL: 378
DEPTH OF CASING: 178

DATE	CONCENTRATION
5- 5-75	13.8 ± 0.7

WELL: DX-68-22-805

DATE	CONCENTRATION
5-19-70	22.4 ± 1.2
4-14-75	17.6 ± .8

WELL: DX-68-23-203
DEPTH OF WELL: 400
DEPTH OF CASING: 33

DATE	CONCENTRATION
7-22-76	4.6 ± .4

SPRING: DX-68-23-301

DATE	CONCENTRATION
8-12-63	2.0 ± .2
3-19-64	2.4 ± .2
11-20-64	2.6 ± .3
5-19-67	6.2 ± .6
4- 1-68	6.3 ± .5
3-17-69	4.4 ± .6
3- 3-70	5.3 ± .4
4-15-71	6.7 ± .4
3-30-72	4.6 ± .3
5-15-73	5.6 ± .4
5-30-74	4.9 ± .3
9-11-75	7.0 ± .5
4- 7-76	3.8 ± .3
7-22-76	4.6 ± .4
4-29-77	7.0 ± .4
4-25-78	6.7 ± .4

WELL: DX-68-23-304
DEPTH OF WELL: 1061
DEPTH OF CASING: 655

DATE	CONCENTRATION
4-26-76	6.3 ± .6
4-29-77	5.6 ± .3

Table 3.--Tritium concentrations in water from wells and springs in the Edwards aquifer--Continued

DATE	CONCENTRATION
COMAL COUNTY--Cont.	
WELL: DX-68-23-315	
4-18-75	8.2 ± 0.5
WELL: DX-68-23-401	
10- 1-75	12.7 ± 1.0
WELL: DX-68-23-505 DEPTH OF WELL: 210 DEPTH OF CASING: 53	
5- 5-75	7.6 ± .4
WELL: DX-68-23-506 DEPTH OF WELL: 250 DEPTH OF CASING: 85	
4- 2-75	8.2 ± .5
WELL: DX-68-23-507	
5- 5-75	4.6 ± .4
WELL: DX-68-24-102 DEPTH OF WELL: 211 DEPTH OF CASING: 60	
10-23-75	9.3 ± .5
WELL: DX-68-30-215 DEPTH OF WELL: 660 DEPTH OF CASING: 185	
6-18-70	4.0 ± .4
5- 5-75	7.5 ± .4
WELL: DX-68-30-312 DEPTH OF WELL: 645 DEPTH OF CASING: 598	
4- 2-75	3.5 ± 0.3
GUADALUPE COUNTY	
WELL: KY-68-30-601	
7-26-71	.4 ± .7
HAYS COUNTY	
WELL: LR-67-01-203 DEPTH OF WELL: 150	
8- 6-75	21.8 ± 1.5
SPRING: LR-67-01-701	
8- 6-75	16.4 ± 1.2
WELL: LR-67-01-801	
3-18-64	29.9 ± 1.6
11-20-64	34.2 ± 1.9
5-19-67	33.5 ± 1.8
4- 1-68	30.7 ± 1.7
3- 7-69	32.5 ± 1.9
3- 3-70	32.6 ± 1.8
3-16-71	26.1 ± 2.1
5-15-73	23.9 ± 1.7
5-30-74	21.1 ± 1.4
5- 1-75	19.1 ± 1.4
5-14-76	18.3 ± .9
4-29-77	17.0 ± 1.0
4-25-78	14.1 ± .9
HAYS COUNTY--Cont.	
WELL: LR-67-09-101 DEPTH OF WELL: 229 DEPTH OF CASING: 130	
11-21-68	24.7 ± 2.0
1- 5-75	19.1 ± .9
WELL: LR-67-09-106 DEPTH OF WELL: 402 DEPTH OF CASING: 238	
12- 9-75	12.1 ± .7
WELL: LR-68-08-601	
6- 4-75	1.2 ± .2
WELL: LR-68-16-301	
6- 4-75	14.8 ± 1.1
WELL: LR-68-16-603 DEPTH OF WELL: 230 DEPTH OF CASING: 154	
8-14-75	13.1 ± .7
MEDINA COUNTY	
WELL: TD-68-33-201	
8-21-75	11.4 ± 1.0
WELL: TD-68-33-301 DEPTH OF WELL: 805 DEPTH OF CASING: 740	
6-16-69	9.3 ± .6
5-13-70	10.8 ± .7

DATE	CONCENTRATION
MEDINA COUNTY--Cont.	
WELL: TD-68-33-602	
7-20-77	5.9 ± 0.3
WELL: TD-68-33-901	
DEPTH OF WELL: 670	
DEPTH OF CASING: 643	
6-21-77	5.8 ± .7
WELL: TD-68-34-103	
DEPTH OF WELL: 1015	
DEPTH OF CASING: 715	
6-21-77	13.3 ± .9
WELL: TD-68-41-303	
DEPTH OF WELL: 717	
DEPTH OF CASING: 631	
7-29-71	3.5 ± .5
WELL: TD-68-41-401	
DEPTH OF WELL: 1971	
DEPTH OF CASING: 1519	
6- 6-71	3.8 ± .3
WELL: TD-68-41-801	
DEPTH OF WELL: 1609	
DEPTH OF CASING: 1433	
11- 5-68	.3 ± .4
WELL: TD-68-42-806	
7-30-71	.4 ± .4
MEDINA COUNTY--Cont.	
WELL: TD-68-49-813	
DEPTH OF WELL: 3194	
DEPTH OF CASING: 2570	
9-17-75	.2 ± 0.2
WELL: TD-69-38-101	
DEPTH OF WELL: 625	
DEPTH OF CASING: 370	
5-28-75	1.5 ± .2
7-28-76	1.1 ± .2
WELL: TD-69-38-601	
DEPTH OF WELL: 538	
DEPTH OF CASING: 74	
6- 5-75	17.4 ± .8
WELL: TD-69-38-902	
DEPTH OF WELL: 1000	
6-19-69	1.4 ± .4
5-11-70	.1 ± .3
6- 5-75	.3 ± .2
6-17-76	.6 ± .2
WELL: TD-69-38-905	
DEPTH OF WELL: 997	
DEPTH OF CASING: 443	
6-17-75	.5 ± .2
WELL: TD-69-39-502	
DEPTH OF WELL: 530	
DEPTH OF CASING: 240	
6-16-69	40.4 ± 2.2
5-13-70	40.7 ± 2.2
6- 6-75	24.7 ± 1.5
MEDINA COUNTY--Cont.	
WELL: TD-69-39-801	
DEPTH OF WELL: 863	
DEPTH OF CASING: 604	
6- 5-75	1.4 ± 0.2
WELL: TD-69-39-802	
DEPTH OF WELL: 980	
DEPTH OF CASING: 525	
6- 6-75	4.3 ± .3
WELL: TD-69-40-202	
6-20-76	5.7 ± .4
WELL: TD-69-40-402	
DEPTH OF WELL: 382	
DEPTH OF CASING: 78	
6- 6-75	8.5 ± .7
WELL: TD-69-40-403	
DEPTH OF WELL: 518	
DEPTH OF CASING: 244	
5-19-75	.7 ± .2
WELL: TD-69-40-501	
DEPTH OF WELL: 930	
DEPTH OF CASING: 522	
6- 7-76	5.1 ± .3
WELL: TD-69-40-803	
DEPTH OF WELL: 1158	
DEPTH OF CASING: 1148	
8- 7-75	2.7 ± .2

Table 3.--Tritium concentrations in water from wells and springs in the Edwards aquifer--Continued

DATE	CONCENTRATION
MEDINA COUNTY--Cont.	
WELL: TD-69-40-901	
8-12-63	5.6 ± 0.5
3-10-64	5.2 ± .5
11-19-64	6.7 ± .5
3- 8-67	8.5 ± .7
4- 5-68	10.3 ± .9
4- 8-69	10.4 ± .7
4-14-70	11.5 ± 1.2
4-15-75	7.5 ± .6
8- 4-76	9.1 ± .5
WELL: TD-69-46-401 DEPTH OF WELL: 1326 DEPTH OF CASING: 1125	
6-17-75	6.0 ± .4
WELL: TD-69-46-402 DEPTH OF WELL: 1982 DEPTH OF CASING: 1325	
6-17-75	6.7 ± .4
WELL: TD-69-46-601 DEPTH OF WELL: 1289 DEPTH OF CASING: 920	
5-19-75	7.4 ± .4
WELL: TD-69-46-602 DEPTH OF WELL: 1685 DEPTH OF CASING: 1208	
6-20-75	8.3 ± .4
WELL: TD-69-46-701 DEPTH OF WELL: 1303	
5-29-75	.1 ± .2
MEDINA COUNTY--Cont.	
WELL: TD-69-46-901 DEPTH OF WELL: 1444 DEPTH OF CASING: 1040	
5-22-71	5.1 ± 0.5
WELL: TD-69-46-902 DEPTH OF WELL: 1313 DEPTH OF CASING: 1100	
5-29-68	7.4 ± .5
7-16-75	9.4 ± .5
WELL: TD-69-47-101 DEPTH OF WELL: 1653 DEPTH OF CASING: 1137	
6- 6-75	8.0 ± .4
WELL: TD-69-47-301	
10-10-61	1.0 ± .5
3- 8-67	1.7 ± .5
4- 5-68	2.4 ± .6
3-26-69	2.0 ± .3
2-19-70	1.9 ± .4
7-28-71	2.4 ± .3
5- 6-75	3.3 ± .3
5-25-76	4.1 ± .3
WELL: TD-69-47-501 DEPTH OF WELL: 1659 DEPTH OF CASING: 1159	
4-29-75	5.5 ± .4
WELL: TD-69-47-602 DEPTH OF WELL: 1395 DEPTH OF CASING: 1261	
4-29-75	6.0 ± .4
MEDINA COUNTY--Cont.	
WELL: TD-69-47-604 DEPTH OF WELL: 1560 DEPTH OF CASING: 1283	
4-15-75	8.3 ± 0.6
WELL: TD-69-47-702 DEPTH OF WELL: 1500 DEPTH OF CASING: 1250	
8-21-75	8.4 ± .5
WELL: TD-69-48-102 DEPTH OF WELL: 1654 DEPTH OF CASING: 1320	
5-29-68	3.0 ± .3
WELL: TD-69-48-202 DEPTH OF WELL: 1717 DEPTH OF CASING: 1287	
5-19-75	1.5 ± .2
WELL: TD-69-54-401 DEPTH OF WELL: 2000	
3-15-77	4.1 ± .2
WELL: TD-69-55-201 DEPTH OF WELL: 2286 DEPTH OF CASING: 1806	
8-21-75	5.1 ± .4
WELL: TD-69-55-701	
10- 6-75	1.1 ± .2

Table 3.--Tritium concentrations in water from wells and springs in the Edwards aquifer--Continued

DATE	CONCENTRATION
MEDINA COUNTY--Cont.	
WELL: TD-69-56-501	
DEPTH OF WELL: 2646	
DEPTH OF CASING: 2122	
11- 5-68	0.9 ± 0.2
UVALDE COUNTY	
WELL: YP-69-35-804	
DEPTH OF WELL: 386	
7-20-62	11.8 ± .7
3-31-67	53.2 ± 2.0
4- 5-68	48.0 ± 2.7
3-26-69	49.3 ± 2.8
6-11-74	26.7 ± 1.8
8-12-76	20.6 ± 1.2
WELL: YP-69-35-805	
DEPTH OF WELL: 600	
DEPTH OF CASING: 100	
5-13-70	32.2 ± 1.7
WELL: YP-69-36-701	
DEPTH OF WELL: 500	
DEPTH OF CASING: 45	
6-24-69	41.4 ± 2.2
5-13-70	89.6 ± 4.8
4-28-71	30.1 ± 1.7
WELL: YP-69-36-901	
DEPTH OF WELL: 1246	
DEPTH OF CASING: 890	
4- 8-69	14.2 ± .9
6-19-70	13.9 ± .9
6-15-71	11.2 ± .7

DATE	CONCENTRATION
UVALDE COUNTY--Cont.	
WELL: YP-69-41-502	
DEPTH OF WELL: 403	
DEPTH OF CASING: 120	
3-31-67	97.2 ± 5.2
WELL: YP-69-41-505	
DEPTH OF WELL: 260	
DEPTH OF CASING: 81	
5-16-67	67.7 ± 2.7
5-13-70	36.3 ± 2.1
WELL: YP-69-41-701	
6-17-71	4.3 ± .5
WELL: YP-69-42-804	
3- 8-67	16.2 ± .9
4-14-70	18.1 ± 1.4
WELL: YP-69-43-602	
DEPTH OF WELL: 1000	
DEPTH OF CASING: 530	
6-11-74	26.9 ± 1.8
8- 5-76	14.3 ± .7
WELL: YP-69-43-03	
DEPTH OF WELL: 1373	
DEPTH OF CASING: 1025	
6-17-76	.1 ± .2
WELL: YP-69-43-804	
DEPTH OF WELL: 967	
DEPTH OF CASING: 365	
6-14-76	2.1 ± .2

DATE	CONCENTRATION
UVALDE COUNTY--Cont.	
WELL: YP-69-43-902	
DEPTH OF WELL: 1476	
DEPTH OF CASING: 796	
6- 7-76	9.7 ± 0.6
WELL: YP-69-43-908	
6-10-76	11.3 ± .6
WELL: YP-69-44-501	
DEPTH OF WELL: 994	
DEPTH OF CASING: 690	
8-21-75	16.9 ± 1.4
WELL: YP-69-44-502	
DEPTH OF WELL: 1380	
DEPTH OF CASING: 870	
6-20-75	7.0 ± .5
WELL: YP-69-44-702	
DEPTH OF WELL: 1604	
DEPTH OF CASING: 958	
6-14-76	2.7 ± .2
WELL: YP-69-44-804	
6-17-76	5.7 ± .3
WELL: YP-69-45-201	
DEPTH OF WELL: 1365	
DEPTH OF CASING: 757	
6-17-76	1.8 ± .2

Table 3.--Tritium concentrations in water from wells and springs in the Edwards aquifer--Continued

UVALDE COUNTY--Cont.

WELL: YP-69-45-404

DATE	CONCENTRATION
8-12-63	4.3 ± 0.6
3-10-64	5.7 ± .5
11-19-64	6.5 ± .4
5-11-67	8.5 ± .5
4-12-68	8.0 ± .5
4- 1-69	10.3 ± .6
4- 1-70	12.0 ± 1.1
7-28-71	11.7 ± .8
9- 7-74	11.4 ± .6
6-17-76	10.9 ± .6

WELL: YP-69-45-703
DEPTH OF WELL: 1670
DEPTH OF CASING: 1146

DATE	CONCENTRATION
6-10-76	1.2 ± .2

WELL: YP-69-45-802
DEPTH OF WELL: 1280
DEPTH OF CASING: 1190

DATE	CONCENTRATION
6-17-76	14.0 ± .8

WELL: YP-69-49-601

DATE	CONCENTRATION
5-16-67	50.5 ± 2.7
7- 9-70	24.3 ± 1.4

WELL: YP-69-50-101
DEPTH OF WELL: 100

DATE	CONCENTRATION
9-10-63	10.2 ± 2.2
4-10-64	11.0 ± 2.1
11-19-64	18.9 ± 2.2
5-11-67	22.1 ± 1.0
3-11-68	18.0 ± .8
4-10-69	19.8 ± 2.4
3-16-70	20.1 ± 1.5
7-26-71	21.0 ± 1.5
6-11-74	17.7 ± .8
7-16-76	12.9 ± .7

UVALDE COUNTY--Cont.

WELL: YP-69-50-308

DATE	CONCENTRATION
5-11-67	16.9 ± .9
4-12-68	13.7 ± .8
4-10-69	11.1 ± 1.3
3-23-70	12.2 ± 1.1
7- 8-71	9.3 ± .7
7- 2-74	12.2 ± .6
8- 3-76	11.6 ± .6

WELL: YP-69-50-410

DATE	CONCENTRATION
6-13-67	33.1 ± 1.9

WELL: YP-69-52-401
DEPTH OF WELL: 1410
DEPTH OF CASING: 300

DATE	CONCENTRATION
5-29-68	4.0 ± .4

WELL: YP-69-53-201
DEPTH OF WELL: 1620
DEPTH OF CASING: 1180

DATE	CONCENTRATION
3-28-75	13.0 ± .7
8-12-76	11.4 ± .6

Table 4.--Isotope analyses and redox potential of water from the Edwards aquifer

Well or station	Date collected	Carbon isotopes: $\delta^{13}C$ (°/oo)	Carbon isotopes: ^{14}C content (% modern ± 1σ)	Sulfur isotopes: Sulfate (mg/L)	Sulfur isotopes: Sulfate ($\delta^{34}S$, °/oo)	Sulfur isotopes: Sulfide (H_2S, mg/L)	Sulfur isotopes: Sulfide (SO_4, °/oo)	Redox potential (volts)
Atascosa County								
AL-68-50-201	7-70	-2.9	2.7 ± 0.4	169	+21.8	0.02	-24.0	-0.083
Bexar County								
AY-68-27-515	7-70	-10.3	--	21	+8.6	.0	--	+.538
AY-68-29-109	7-70	-10.8	73.8 ± .7	7.8	+15.2	.0	--	+.547
AY-68-35-904	7-71	-8.5	59.9 ± 1.0	15	+10.6	.0	--	+.569
AY-68-36-102	7-71	-8.9	73.6 ± .6	29	+13.3	.0	--	+.569
AY-68-37-104	7-70	-8.6	83.6 ± 1.1	31	+11.5	.0	--	+.566
AY-68-37-701	7-70	-8.1	55.6 ± .7	26	+13.4	.0	--	+.503
AY-68-37-702	7-70	.0	3.9 ± .6	1440	+22.2	55	-10.0	-.320
AY-68-38-101	7-71	-4.3	21.0 ± .6	195	+26.7	.04	-20.0	-.042
AY-68-38-301	7-71	-4.0	<1.2	1880	+21.3	19	-15.1	-.122
AY-68-43-702	7-70	-4.7	22.3 ± .6	466	+21.3	13	-11.5	-.190
AY-68-43-703	7-71	--	22.8 ± .6	490	+20.1	11	-11.9	-.005
AY-68-43-809	7-71	-5.3	34.2 ± .6	220	+19.1	3.2	-12.3	--
AY-68-43-810	7-70	-6.5	--	187	+20.0	3.7	-14.6	-.145
AY-68-44-210	7-71	-5.4	32.0 ± .4	211	+18.3	1.3	-17.6	+.044
AY-68-44-401	7-70	-8.4	--	25	--	--	--	+.487
AY-68-44-404	7-70	-4.8	--	730	+22.5	22	-19.5	-.155
AY-68-45-101	7-71	-3.1	<2.2	2000	+20.6	53	-14.3	-.154
AY-68-45-301	7-70	-4.6	<2.4	1850	+22.0	46	-14.4	-.182
AY-68-45-802	7-70	-3.2	<1.0	1780	+21.7	63	-13.2	-.195
Comal County								
DX-68-23-301	7-71	-9.2	65.1 ± .6	23	+12.8	.0	--	+.590
DX-68-30-312	7-71	--	--	29	+8.3	.0	--	--
Guadalupe County								
KX-68-30-601	7-71	-3.3	<1.4	619	+22.0	71	-27.1	-.114
Medina County								
TD-68-41-303	7-71	--	--	14	+10.5	.0	--	+.580
TD-68-41-801	7-70	-6.2	5.8 ± .4	10	--	.045	--	-.087
TD-68-42-806	7-71	-5.7	24.5 ± .6	15	+14.9	.0	--	+.534
TD-69-40-901	7-70	-9.6	52.2 ± .7	22	+14.0	--	--	+.529
TD-69-47-301	7-71	-8.4	62.4 ± .6	16	+13.3	.0	--	-.587
Uvalde County								
YP-69-45-404	7-71	-8.5	65.6 ± .7	83	+19.1	.0	--	--
Nueces River								
08190000	7-71	-4.9	116.0 ± 1.1	13	+11.3	.0	--	--
Frio River								
08195000	7-71	-9.3	118.0 ± 1.1	16	+10.9	.0	--	--

Note: δ isotope (°/oo) = $\left(\frac{\text{Isotope ratio of sample}}{\text{Isotope ratio of standard}} - 1\right) \times 1000$.

σ = standard deviation.

Table 5.--Calculated dissolved carbonate, partial CO_2 pressures, and saturation indices of selected minerals in water from the Edwards aquifer

Location	Sample no.	Date collected	Water facie	Total dissolved carbonate (mg/L)	Partial CO_2 pressure (atmospheres)	Saturation indices: Calcite	Dolomite	Gypsum	Celestite	Strontianite	Fluorite
					RECHARGE GROUP						
Nueces River	A[a]	7-71	Aaca	3.68	0.002	+0.56	+0.93	--	--	--	--
	A[b]			3.92	.008	+.03	-.14	--	--	--	--
Frio River	B[a]	7-71	Aabd	3.38	.002	+.65	+1.16	--	--	--	--
	B[b]			3.63	.007	+.02	-.10	--	--	--	--
RP-70-45-501	1	10-72	Aaab	4.50	.013	-.01	-.71	--	--	--	--
do.	2	2-73	Aaab	4.05	.008	+.07	-.53	--	--	--	--
RP-70-45-601	3	--	Aaab	4.89	.024	-.23	-1.18	--	--	--	--
YR-70-41-301	4	10-72	Aaab	4.67	.015	-.05	-.74	--	--	--	--
do.	5	2-73	Aaab	4.29	.012	-.04	-.72	--	--	--	--
do.	6	10-73	Aaab	4.38	.012	-.01	-.50	--	--	--	--
YP-69-50-101	7	7-71	Aabc	4.83	.016	-.04	-.60	--	--	--	--
TD-69-39-501	8	2-74	Aaac	4.90	.023	-.29	-1.00	--	--	--	--
AY-68-29-104	9	3-72	Aaab	7.63	.043	-.10	-.51	--	--	--	--
AY-68-29-109	10	7-70	Aaaa	6.87	.036	-.14	-.85	--	--	--	--
DX-68-15-901	11	10-72	Aaaa	6.83	.032	-.09	-.58	--	--	--	--
do.	12	5-73	Aaaa	6.40	.026	-.02	-.69	--	--	--	--
do.	13	11-73	Aaaa	6.61	.030	-.08	-.73	--	--	--	--
AY-68-27-515	14	7-70	Aaab	5.41	.017	-.02	-.37	--	--	--	--
YP-70-56-201	58	10-72	Aaac	8.39	.057	-.10	-1.21	--	--	--	--
					MAIN FRESHWATER GROUP						
AY-68-29-702	15	3-72	Aaba	5.47	.017	+.02	-.36	--	--	--	--
AY-68-29-913	16	3-72	Aabd	4.79	.016	-.08	-.42	--	--	--	--
AY-68-30-104	17	3-72	Aabd	6.43	.030	-.13	-.60	--	--	--	--
AY-68-35-904	18	7-71	Aabd	4.43	.012	-.05	-.28	--	--	--	--
AY-68-36-102	19	7-71	Aabd	5.29	.015	+.01	-.26	--	--	--	--
AY-68-36-601	20	11-73	Aabd	4.95	.022	-.24	-.76	--	--	--	--
AY-68-36-908	21	12-73	Aabd	4.55	.015	-.10	-.37	--	--	--	--
AY-68-37-104	22	7-70	Aabd	4.77	.015	-.13	-.48	--	--	--	--
AY-68-37-115	23	11-73	Aabd	5.07	.020	-.16	-.58	--	--	--	--
AY-68-37-202	24	3-72	Aabd	4.37	.010	+.08	-.06	--	--	--	--
AY-68-37-701	25	7-70	Aabc	4.44	.015	-.13	-.39	--	--	--	--
AY-68-42-312	26	3-72	Aabd	4.51	.013	-.06	-.39	--	--	--	--
AY-68-42-804	26	3-62	Aabd	4.19	.008	+.18	+.19	--	--	--	--
AY-68-43-601	28	9-73	Aabc	4.54	.014	-.03	-.26	--	--	--	--
AY-68-44-301	29	12-72	Aabc	4.36	.011	+.08	-.03	--	--	--	--
AY-68-44-401	30	7-70	Aacc	4.46	.015	-.12	-.39	--	--	--	--
DX-68-23-301	31	7-71	Aabd	5.23	.015	+.02	-.23	--	--	--	--
do.	32[c]	5-73	Aabd	5.24	.017	+.42	-.70	--	--	--	--
	32[d]			5.22	.017	-.04	-.35	--	--	--	--
do.	33	11-73	Aabd	5.31	.021	-.12	-.50	--	--	--	--
DX-68-30-312	34	7-71	Aacb	4.93	.018	-.12	-.47	--	--	--	--
LR-67-01-801	35	3-73	Aaca	5.81	.022	-.10	-.47	--	--	--	--
do.	36	5-73	Aaca	5.65	.018	+.01	-.28	--	--	--	--
TD-68-41-303	37	7-71	Aabd	4.61	.015	-.12	-.48	--	--	--	--
TD-68-42-503	38	8-72	Aabd	4.70	.021	-.30	-.78	--	--	--	--
TD-68-42-806	39	7-71	Aabd	3.99	.012	-.01	-.14	--	--	--	--
TD-69-40-901	40	7-70	Aabd	4.87	.022	-.30	-1.00	--	--	--	--
TD-69-46-601	41	4-72	Aabd	4.71	.015	-.09	-.47	--	--	--	--
TD-69-46-402	42	7-72	Aabd	4.34	.008	+.10	-.04	--	--	--	--
TD-69-46-903	43	4-72	Aabd	4.62	.016	-.17	-.64	--	--	--	--

a Calculated with reported pH = 8.10.
b Calculated with estimated pH = 7.45.
c Calculated with reported Ca^{+2} = 30 mg/L.
d Calculated with estimated Ca^{+2} = 77 mg/L.

Table 5.--Calculated dissolved carbonate, partial CO_2 pressures, and saturation indices of selected minerals in water from the Edwards aquifer--Continued

Location	Sample no.	Date collected	Water facie	Total dissolved carbonate (mg/L)	Partial CO_2 pressure (atmospheres)	Saturation indices: Calcite	Dolomite	Gypsum	Celestite	Strontianite	Fluorite
				MAIN FRESHWATER GROUP--Continued							
TD-69-47-301	44	7-70	Aabd	4.62	.014	-.09	-.40	--	--	--	--
do.	45	7-71	Aabd	4.69	.912	-.02	-.24	--	--	--	--
TD-69-47-501	46	10-73	Aabd	4.54	.013	-.08	-.39	--	--	--	--
TD-69-48-102	47	4-72	AAbd	4.36	.101	+.07	-.02	--	--	--	--
YP-69-43-102	48	10-72	Aabc	4.50	.010	+.04	-.22	--	--	--	--
YP-69-43-107	49	2-74	Aaac	4.63	.016	-.18	-.70	--	--	--	--
YP-69-44-101	50	2-73	Aabd	4.09	.009	-.06	-.36	--	--	--	--
YP-69-45-704	51	10-72	Aacc	4.58	.011	+.08	-.21	--	--	--	--
				WESTERN VARIED GROUP							
AY-68-51-201	69A[a]	3-75	Bcba	6.83	.149	-.35	-.98	+.09	-.03	-1.50	+.10
do.	69A[b]			5.13	.066	-.00	-.28	+.09	-.03	-1.15	+.10
RP-70-44-801	52	10-72	Bbba	4.80	.040	+.05	-.54	+.17	-.12	-1.17	+.09
YP-69-43-980	53	4-72	Bbdd	4.93	.026	+.03	-.34	-.86	-1.32	-1.29	-1.74
YP-69-43-909	54	10-73	Badc	4.74	.010	+.02	-.19	-1.06	-1.06	-.86	-1.60
YP-69-53-703	55	4-72	Abcb	4.25	.018	+.02	-.12	-1.30	-.44	-.07	-.03
YP-69-51-401	56	4-72	Abca	5.83	.029	-.07	-.72	-1.49	-1.87	-1.30	-1.72
YP-69-51-103	57	4-72	Abbd	5.62	.027	-.07	-.61	-1.24	-1.22	-.92	-1.45
YP-69-45-404	79	7-71	Abca	4.60	.012	-.01	-.16	-1.49	-2.13	-1.50	-1.89
YP-69-50-105	59	10-72	Aabc	4.63	.016	-.05	-.63	-2.12	-3.22	-2.00	-2.37
TD-68-41-801	60	7-70	Adbb	4.54	.006	+.10	+.33	-2.61	-2.36	-.50	-.29
TD-68-34-103	61	8-72	Aabc	4.31	.010	-.03	-.20	-1.74	-2.29	-1.43	-1.92
YP-69-44-502	62	4-72	Aabd	4.45	.014	+.02	-.24	-2.09	-1.85	-.65	-1.93
TD-68-41-401	63	8-72	Aaad	4.50	.009	+.19	+.07	-2.30	-2.74	-1.11	-2.12
				WESTERN SALINE AND TRANSITIONAL WATER GROUP							
AY-68-45-101	64	7-71	Bcbd	5.12	.047	+.01	+.05	+.06	-.06	-1.09	+.31
AY-68-45-301	65	7-70	Bcba	5.06	.051	+.03	+.05	+.03	-.04	-1.04	+.42
AY-68-45-802	66	7-70	Bbcd	5.00	.060	-.02	-.02	+.00	-.09	-1.14	+.38
do.	67	7-71	--	4.75	.055	-.01	-.03	+.04	-.06	-1.13	+.27
AY-68-45-901	68	1-73	Bbcc	5.52	.065	+.08	+.13	+.08	-.06	-1.10	+.13
AY-68-51-201	69	9-73	Bcba	5.70	.052	+.09	+.21	-.04	-.12	-.97	+.46
AY-68-44-404	70	7-70	Bbcd	4.85	.023	+.09	-.20	-.43	-.42	-.81	+.12
AY-68-43-702	71	7-70	Bcaa	4.79	.035	-.04	-.16	-.64	-.63	-1.00	-.23
AY-68-43-703	72	7-71	Bbdd	4.35	.022	+.06	+.05	-.63	-.54	-.79	-.62
AY-68-44-210	73	7-71	Bacd	4.39	.015	+.06	+.11	-1.08	-1.05	-.83	-.70
AY-68-43-809	74	7-71	Bacd	4.37	.024	-.11	-.28	-1.06	-.92	-.92	-.98
AY-68-43-810	75	7-70	Bbdd	4.45	.021	-.04	-.07	-1.16	-.84	-.66	-.95
TD-68-49-813	76[c]	3-73	Dtbc	4.47	.014	+.28	+.58	-1.30	-.13	+.42	-.09
	76[d]			4.72	.026	+.04	+.08	-1.30	-.13	+.18	-.09
do.	77	3-73	--	4.52	.021	+.05	+.11	-1.30	-.10	+.24	-.03
AL-68-50-201	78	7-70	Bada	4.37	.019	+.00	+.05	-1.26	-.18	+.11	-.37
				EASTERN SALINE AND TRANSITIONAL WATER GROUP							
DX-68-16-602	80	11-72	Bccc	9.90	.074	+.10	+.36	+.14	-.06	-.95	-.06
AY-68-38-301	81	7-71	Cbba	6.42	.052	-.01	-.00	+.00	-.11	-1.04	+.22
AY-68-37-702	82	7-70	Bccb	7.20	.046	+.09	+.28	-.11	-.13	-.82	+.42
AY-68-23-807	83[e]	10-72	Cbab	6.62	.006	+.62	+1.56	-.78	-.18	+.36	-22
	83[d]			7.39	.027	+.03	+.39	-.78	-.18	-.23	-.22
KX-68-30-601	84	7-71	Bcdc	5.06	.018	+.01	+.21	-.62	-.10	-.34	+.10
AY-68-37-602	85	1-73	Bcad	4.63	.015	+.04	+.19	-.92	-.98	-.92	-.46
AY-68-38-101	86	7-71	Btcb	4.32	.015	-.02	-.01	-1.18	-1.24	-1.00	-1.03
AY-68-37-706	87	12-73	Abad	4.64	.019	-.19	-.51	-1.74	-1.95	-1.28	-1.94
AY-68-37-704	88	12-73	Abad	4.63	.019	-.09	-.21	-1.85	-1.29	-.45	-1.41
AY-68-30-802	89	3-72	Abda	4.33	.011	+.06	-.07	-1.90	-2.12	-1.05	-2.19

a Calculated with reported pH = 6.20
b Calculated with estimated pH = 6.55
c Calculated with reported pH = 7.35.
d Calculated with estimated pH = 7.10.
e Calculated with reported pH = 7.70.

Table 6.--Hydrochemical facies of the Edwards aquifer

Aquifer location	Water type	Hydrochemical facies
Unconfined area (rapid infiltration of ground water to aquifer)	Calcium bicarbonate	Aaaa, Aaab, Aaac, Aaad
Confined, freshwater area (zone of rapid ground-water circulation)	Calcium bicarbonate	Aabd, Aabc, Aaca, Aacb
Confined, freshwater area (zone of slower ground-water circulation)	Calcium magnesium bicarbonate	Abad, Abda, Abca, Abcd, Abdd, Atbd
Confined, more highly mineralized freshwater (zone of slower ground-water circulation)	Calcium magnesium sulfate	Badc, Bbdd, Bcab, Babb
Confined saline water (zone of very slow ground-water circulation)	Calcium sulfate chloride	Bccb, Bccc, Bccd, Cbba, Cbcd, Cbbc
Lower confining bed (Upper Glen Rose Formation)	Calcium magnesium sulfate	Bbba, Bbbc, Bbab